The Place of Authentic Technological Practice and Assessment in Technology Education

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Abstract

Technology Education was first introduced to the New Zealand curriculum in 1999. Its introduction has provided challenges for teacher professional development providers and teachers. Many teachers have had either little or no professional development and therefore struggle to plan and implement programmes that reflect authentic technological practice. Assessment of technology has been of particular concern given the intense climate of accountability in schools. Because of its holistic nature assessment practices must be an integrated part of students' technological practice. My study addresses these problems by identifying authentic student technological practice and discussing the teachers' role in teaching and assessing their students. Teachers require quality professional development and an accurate understanding of technological practice if they are to work effectively with students in technology education.

The focus for this research is on one technology assessment task administered to Year 4 children in the National Education Monitoring Project (NEMP) 'Aspects of Technology, 2000'. This is used as a framework to explore the challenges of making assessment authentic in technology education. It is argued that the achievement levels of the children can be improved if the task is a part of the technological practice related to the field of study apparent in the task rather than a previously unsighted 'out-of-context' task. It is also debated that for teachers to be able to plan and implement a unit of work that is based on authentic technological practice they must have a good understanding of the conceptual, procedural, technical and societal knowledge relevant to the practice.

A three staged approach is used in this research. The first stage involved the selected teachers in professional development exploring Learning in Technology Education (LITE) research and unit planning strategies. For this purpose one NEMP task was incorporated into a cooperatively planned unit of work. In Stage Two an 'out-of-context' NEMP task was presented to six children from each of three of the six schools, one in each decile band. In Stage Three the teachers were interviewed about their intended practices. The unit of work was then taught in each of the six classes. During the unit the task was again administered to six children in each class as an integrated part of the unit. Both tasks were administered and analysed according to the 'Aspects of Technology NEMP 2000' guidelines and criteria. This made it possible to compare the 'out-of-context' task with the 'in-context' task. After the unit was taught the teachers were interviewed again to discuss their actual practice. Analysis of both sets of data allowed the comparison of achievement levels of children participating in an isolated 'out-of-context' task to that, which was embedded in authentic technological practice ('in-context').

The results showed that the children who attempted the task as an 'in-context' task achieved at a higher level than those who completed the task as a previously unsighted 'out-of-context' task did. My findings demonstrate that in order to gain a realistic understanding of the levels of achievement in technology education through assessment of technological outcomes, these outcomes should be an integral part of authentic technological practice.

While the results indicate that assessment tasks need to be an integral part of authentic technological practice this study acknowledges that students' technological practice differs from that of real technologists. There are a number of reasons cited for this to do with the age of the students, school politics and facilities, external assessment requirements and the presence of the teacher in the role as mentor. The study theorises that the quality of teacher knowledge impacts on the quality of intervention given, altering students' technological practice. These ideas are presented in a Model of Student Technological Practice.

The study concludes with recommendations for improving the pre-service training of teachers and the up-skilling of existing teachers in technology education, and on the organisation and development of national assessment tasks in technology education for NEMP.

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Rationale

During 1996 and 1997 the Ministry of Education ran contracts for the professional development of teachers in technology education. As a facilitator employed to deliver this professional development I became concerned about issues of authenticity in both planning and assessment. This concern prompted the writing of an article *The Place of Authenticity in Technology in the New Zealand Curriculum* (Turnbull, 2002).

Subsequently as a member of the National Education Monitoring Project (NEMP) advisory panel I was involved in assessment task selection for technology education. In this role I became similarly concerned about how the tasks were presented and administered to children. The practices being promoted seemed to contradict authentic technological practice and I began asking myself whether the context of the task given to children could in fact influence achievement levels when assessing technology education.

Focus for this Study

The focus for this study was assessment in technology using a NEMP task given in two different contexts, an 'out-of-context' task (previously unsighted by the students) and as a part of technological practice embedded within a unit ('in-context' task). My interest lay in comparing the difference in achievement levels for a selected task given as an 'out-of-context' task previously unsighted by the children with the achievement levels for the same task embedded in authentic technological practice (in-context). The aim was to provide teachers with professional development using current research, support in writing, implementing and assessing a unit of work and guidance in assessment of technology education.

The following sections include defining authenticity, exploring assessment issues and challenges, professional development needs in technology all within the context of NEMP and an outline of the remaining chapters.

Authenticity

The question of what is meant by authentic practice is worthy of closer investigation and clarification. *Technology in the New Zealand Curriculum* states quite clearly, in several places, that technology education for students needs to be real. However, the exact meaning of "real" is not clearly defined and in my experience causes confusion for teachers (Turnbull, 2002). Many teachers interpret this to mean that any problem solved through the technological process needs to be a problem currently real to the children. Hennessy and Murphy (1999) discussed the possibility that authentic practice actually happened at two levels. "Real" to the students may be real to their own lives, or real to situations that they may encounter in the future workplace. The second level is real to technological practice, reflecting the practice of practitioners as much as is practicable in the classroom situation. The first of Hennessy and Murphy's definitions of 'real' includes the meaning often taken by teachers but expands it to include **possible future problems**. The wider implication of this is that any problem solved by children needs to be within the normal practice of a student's culture not their immediate lives. For example it would not be 'real' or authentic to get New Zealand children to design and produce a meat product using seal, moose, cat, dog or horse meat as these meats are not used in our culture. On the other hand it would be authentic to ask them to design a new beef, lamb or pork meat product.

The Vanderbilt Group (1990) also considered authenticity at two levels. The first level considered how the objects and data reflected a factual level of authenticity. Medway (1989) argues that these may be simplified, compared to the real thing, yet still true to life. Thus students can be involved in the use of authentic tools and information but their practice may occur within the bounds of the classroom. The second involved the degree to which the tasks that were performed by the students were authentic. The setting for the project may have been authentic but the tasks contrived. This is the level of authenticity which I believe informed the framework of *Technology in New Zealand Curriculum.* (Turnbull, 2002). It is this level of authenticity that is supported by the research and theory which is discussed in later in this paper. "Activity is said to be authentic if it is (i) coherent and personally meaningful and (ii) purposeful within a social framework- the ordinary practices of culture." (Hennessy & Murphy, 1999, p.8). An important message about the nature of activities that children undertake is that authentic learning engages children and encourages learning (Hennessy & Murphy, 1999; Hill & Smith, 1998; Rogoff, 1990).

With regard to definition of technological practice, Pacey (1983) has discussed the contribution of three aspects (cultural, organisational and technical) of technological practice to the process of problem solving to meet identified needs. Gawith (2000) built on Pacey's aspects with the identification of an holistic view of technological practice which is encompassed by society, driven by purposeful action, and informed or influenced by knowledge, resources, organisation and the development of techniques. Moreland, Jones and Chambers (2001) have also identified the importance of establishing knowledge and identify four domains; procedural, conceptual, societal and technical necessary to successful technological practice. Medway (1989) stated that tacit knowledge (knowledge that is an automatic part of their practice) was fundamental to the practitioner and much of this knowledge could be gained from experience rather than academically. My working definition of student technological practice encompasses Pacey's three aspects and Gawith's holistic view of purposeful action informed by knowledge, skill, organisation, resources and influenced by societal and cultural practice. I acknowledge that students are often constrained by influences beyond their control including; school culture and policy, their physical capabilities, school facilities and equipment, external assessment requirements and teacher knowledge. Students are in the enviable position in that they have a teacher to guide and develop their technological practice. Teacher knowledge in the four domains of knowledge and of holistic technological practice will influence the quality student technological practice.

Issues of Assessment

Technology is a practical subject. Students benefit from formative assessment as they progress through their skill development in technology education. Assessment occurs at a series of stages throughout technological practice. Stages for assessment are determined by teachers and/or students and are placed at key points to ensure identification and comprehension of relevant processes. This will determine whether students are able to continue their practice safely and successfully. Understanding of relevant knowledge and/or skills will enhance this process. In order to measure progress in technology education in a valid way, an understanding of the complexity of the progression in technological literacy is required (Moreland et al., 2001).

Technology is unique in that processes of design and development are assessed. Assessment of students' capability to design and develop tangible outcomes which meet identified needs is much more complex than the assessment of just their knowledge and skills. Progression and what to assess is also an important issue in technology.

Professional Development

Technological literacy occurs through the development of technological knowledge and understanding, technological capability and an awareness of the relationship between technology and society (Ministry of Education, 1995). Teachers currently lack a shared comprehensive understanding of technological literacy and progression. Understandings of formative and summative approaches of assessment and an understanding of the technology curriculum are also needed to provide valid information about progression in technology education. To gain a complete understanding of progress in technology full understanding of technological practice must be identified. It is my opinion that assessment in technology is of value when it enables students to be immersed in authentic technological practice, and involves four domains of knowledge: societal, conceptual, procedural and technical identified by the LITE research carried out by Jones and Moreland (2001). These domains form a useful framework for my research project.

This paper discusses models of teacher change (Hargreaves & Fullan, 1992; Stoll & Fink, 1996) and professional development (Fullan, 1991; Joyce & Showers, 1995) that allow teachers to learn, engage and take ownership of new ideas. New Zealand models of professional development in technology are discussed and compared to the model used in this paper (Chamberlain, Weenink, & Renwick, 1999; Dewar & Bennie, 1996; Scott & Murrow, 1998).

The National Education Monitoring Project

The National Education Monitoring Project (NEMP) provides a context for exploring the teaching and assessment of technology education. The project commenced in New Zealand in 1995 undertaking the assessing and reporting achievement and attitudes of New Zealand primary and intermediate school children. The purpose of national monitoring is to provide information so patterns of performance can be recognised, successes celebrated, and desirable changes to practice and resources identified and implemented (Crooks & Flockton, 2001). NEMP provides a 'national "snapshot" of children's knowledge, skills and motivation, and a way to identify which aspects were improving, staying constant, or declining' (Crooks & Flockton, 2001, p. 5). Two levels, Years 4 & 8 (eight-nine and 11- 12 years) are assessed in all curriculum areas over a four-year cycle. Technology was first assessed in 1996 and Aspects of Technology were assessed on 2000 (Crooks & Flockton, 2001).

Outline of Topics for Remaining Chapters

Chapter Two explores *Technology in the New Zealand Curriculum* and its underlying principles. Two models of technological practice are introduced and discussed. These are followed by a range of theoretical perspectives which contribute to an understanding of authentic practice and assessment in technology education. It also reviews recent New Zealand research relevant to assessment practices in technology in New Zealand. The nature and characteristics of authentic assessment tasks and desirable strategies for assessing technology are discussed. Finally, models of teacher change and teacher professional development relevant to this project are discussed with reference to models of professional development used by the Ministry of Education in technology education.

Chapter Three introduces the NEMP task which is the focus for my study. I explain the sample selection and outline the procedures I used for providing professional development and implementing the technology unit.

The results of the 'out-of-context' and 'in-context' tasks are presented in Chapter Four. These results are illustrated with annotated examples of the children's work showing the assessment criteria.

In the final chapter the findings are discussed in relation to the research questions. Results of the two tasks are compared and contrasted by aspect. Three themes are discussed in relation to the tasks. They are the role teacher intervention has on student technological practice, how student technological practice is enhanced further still if teacher knowledge is sufficient and appropriate in content and timing. Very clear links are given between the learning experiences undertaken by the children and the domains of knowledge identified by the LITE research team (Jones and Moreland 2001). Finally the theme student technological practice is developed further culminating in a model identifying the key features of student technological practice. The chapter concludes with recommendations for teacher education and the National Education Monitoring Project (NEMP).

Chapter Two: Literature Review

Introduction

In this chapter the intended purpose *of Technology in the New Zealand Curriculum is* discussed alongside definitions of technological practice. These include models of technological practice by Pacey and Gawith followed by a discussion of the theoretical underpinnings that have influenced the development of *Technology in the New Zealand Curriculum*. Here I argue the importance of children being engaged in meaningful and authentic technological practice which is within their range of existing or possible future experiences. This is followed by a discussion of the LITE (Learning in Technology Education) Research project, which serves as a framework for exploring the domains of knowledge and discussion of authentic assessment practices, tasks and issues. The chapter concludes with a list of implications for teacher development in technology education.

Technology in the New Zealand Curriculum

The technology curriculum document defines technology education as

> Technology education is a planned process designed to develop students' competence and confidence in understanding and using existing technologies and in creating solutions to technological problems. It contributes to the intellectual and practical development of students, as individual and as informed members of a technological society (Ministry of Education, 1995, p.7).

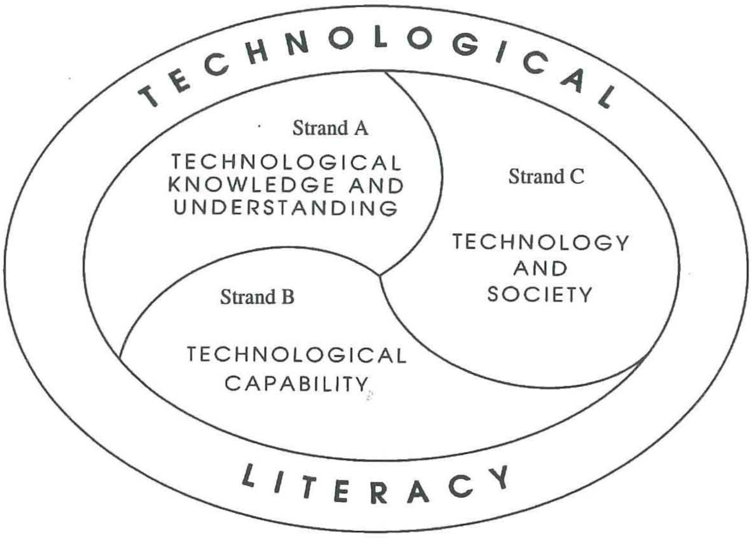
Technology education was introduced to New Zealand education system with its inclusion in the *New Zealand Curriculum Framework* in 1993 (Ministry of Education, 1993). *Technology in the New Zealand Curriculum* was circulated as a draft in 1993 and the final statement was published in 1995. However, despite official recognition in 1996 there was considerable delay in its implementation and technology educationdid not become compulsory in the classroom until January 1999.

The technology curriculum fits into the *New Zealand Curriculum Framework* as one of the essential learning areas. The organisation of learning is divided into eight levels of achievement with eight achievement objectives. The general aim of technology education *in Technology in the New Zealand Curriculum* is to develop technological literacy through:

- technological knowledge and understanding

- technological capability
- an understanding and awareness of the interrelationships between technology and society (Ministry of Education, 1995).

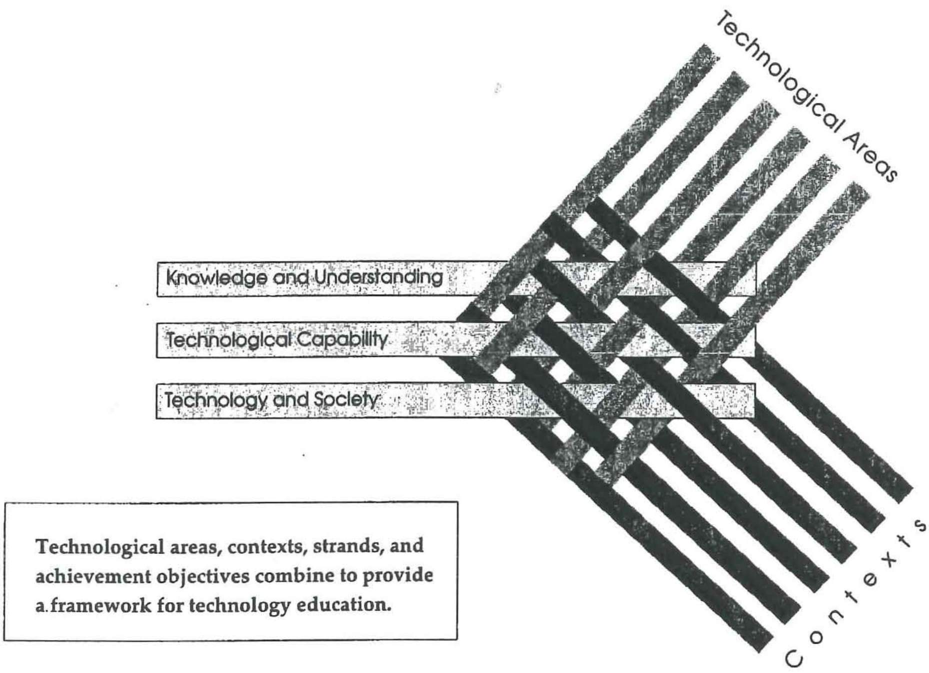
Figure 2.1: ***The Aims of Technology in the New Zealand Curriculum***
(adapted from Ministry of Education, 1995, p. 8).



Each aspect of the aim forms the basis for each of three strands: *Strand A*, Technological Knowledge and Understanding; *Strand B*, Technological Capability and *Strand C*, Technology and Society. Strand A involves the understanding of the use and operation of existing technologies, the technological principles and systems, understanding the nature of technological practice and how existing technologies are communicated, promoted and evaluated. In Strand B the students produce technological solutions which meet an identified need (identification of need by the student, teacher or community). The students are required to use a design process to develop solutions, this involves generating solutions, selecting appropriate ideas, managing time and resources, making their preferred solution, presenting and communicating their ideas and evaluating their designs. In Strand C students investigate the impacts technology on people in the past, present or possible future or in local national or international settings and how people (ethics, culture, gender values etc.) influence technological development.

Implementation of technology has been particularly challenging for schools and teachers. One of the reasons for this is that the structure of the curriculum is complex because students not only work across all **three strands** but also within one or two of the **seven technological areas**: Biotechnology, Food Technology, Electronics and Control Technology, Information and Communication, Materials Technology, Production and Process Technology and Structures and Mechanisms within any one unit. Learning also occurs within a range of **nine contexts**: Personal, Home, School, Recreational, Community, Environmental, Energy, Business and Industrial. The following diagram illustrates the interconnectedness of these aspects of the curriculum (Ibid.).

Figure 2.2: ***Interconnectedness of Areas, Contexts and Strands in Technology in the New Zealand Curriculum***



(Ministry of Education, 1995, p.13)

Students at different levels are required to cover units of work that cover a prescribed number of technological areas over a one to two year period. For example, students in Years One to Three are required to cover four technological areas over this period (Ministry of Education, 1995). Where technology differs from other curricula is that when students complete a unit of work in technology they work towards meeting achievement objectives in all three strands. All technology units produce a 'tangible outcome' and therefore students are involved in design processes and problem solving (Ministry of Education, 1995).

The introduction of this new curriculum has brought many challenges for teachers particularly in the ways that they might teach conceptual and procedural knowledge (Gawith, 2000). A research study undertaken by Gawith (2000) is particularly useful for technology because it has illuminated the basic elements and knowledge structures. These include elements such as techniques, work environment and societal organisation and influences. Knowledge structures include such things as knowledge of organisational matters, required information and knowledge of resources required for the technological practice. This illustrates the influence of available equipment, knowledge, attitudes to risk and innovation on student technological practice and outcomes.

Technological Practice

Two models of technological practice are linked to the philosophy of *Technology in the New Zealand Curriculum.* The first is Pacey's (1983) model of technological practice (Figure 2.3). Pacey conceptualises a model for technological development within organisational structures which includes three aspects. A cultural aspect recognises people's values and beliefs. This represents not only the values and beliefs of the technologist but also those for whom a solution is being developed; this may range from a client in a formal sense to an informal arrangement for friends and family. An organisational aspect includes the management of technological development by a society. This includes many parts that are out of the individual technologist's influence or immediate control for example, political and economic policy, and trade union organisations. The technical aspect includes knowledge, skills and organisation which contribute immediately to technological problem solving.

Figure 2.3: *Pacey's Model of Technology Practice (1983)*

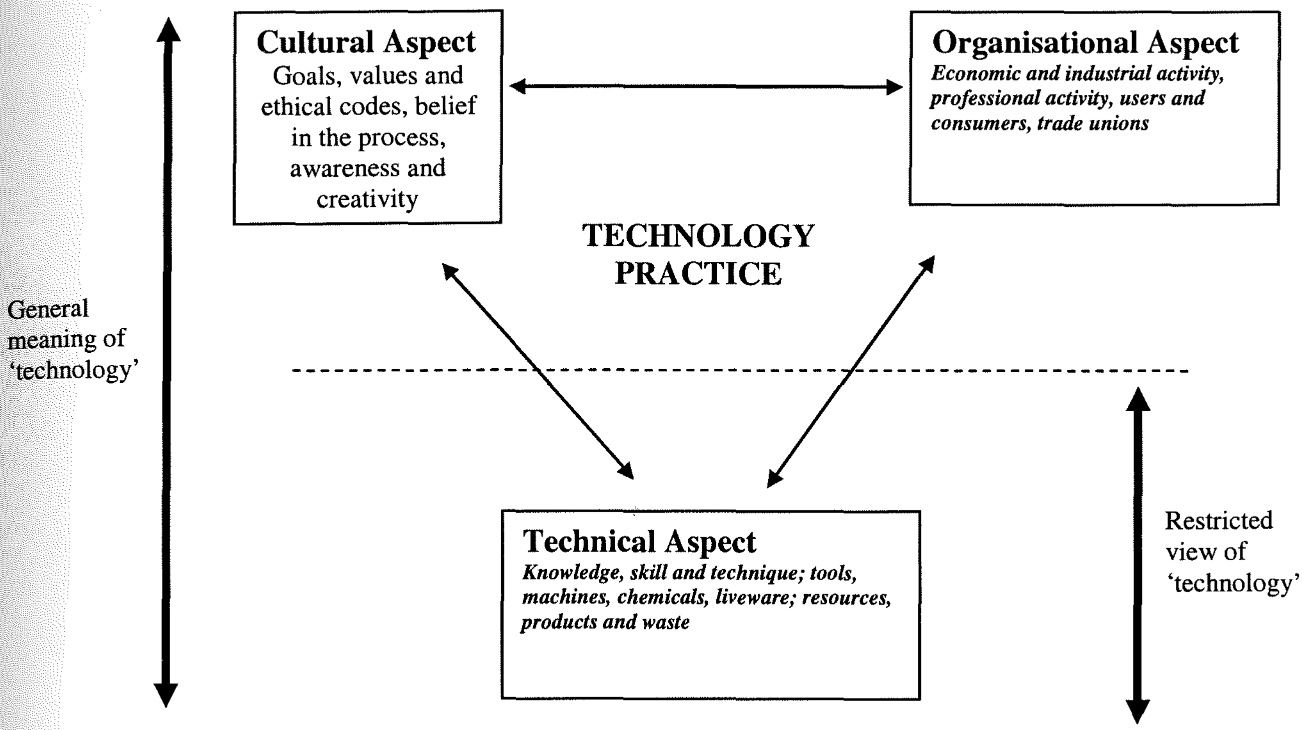


Figure 2.3 shows how these aspects allow the consideration of the holistic nature of technological practice and expand considerably the traditional view of technology which was limited to features of the technical aspect only. For children to be fully immersed in technological practice they need to be aware of and practice all three aspects, not just the technical aspect. Each aspect has links to the three strands in *Technology in the New Zealand Curriculum* mentioned earlier in this chapter (1983, cited in J. Burns, 1997). Table 2.4 illustrates how the aspects of Pacey's model link to the *Technology in the New Zealand Curriculum* document.

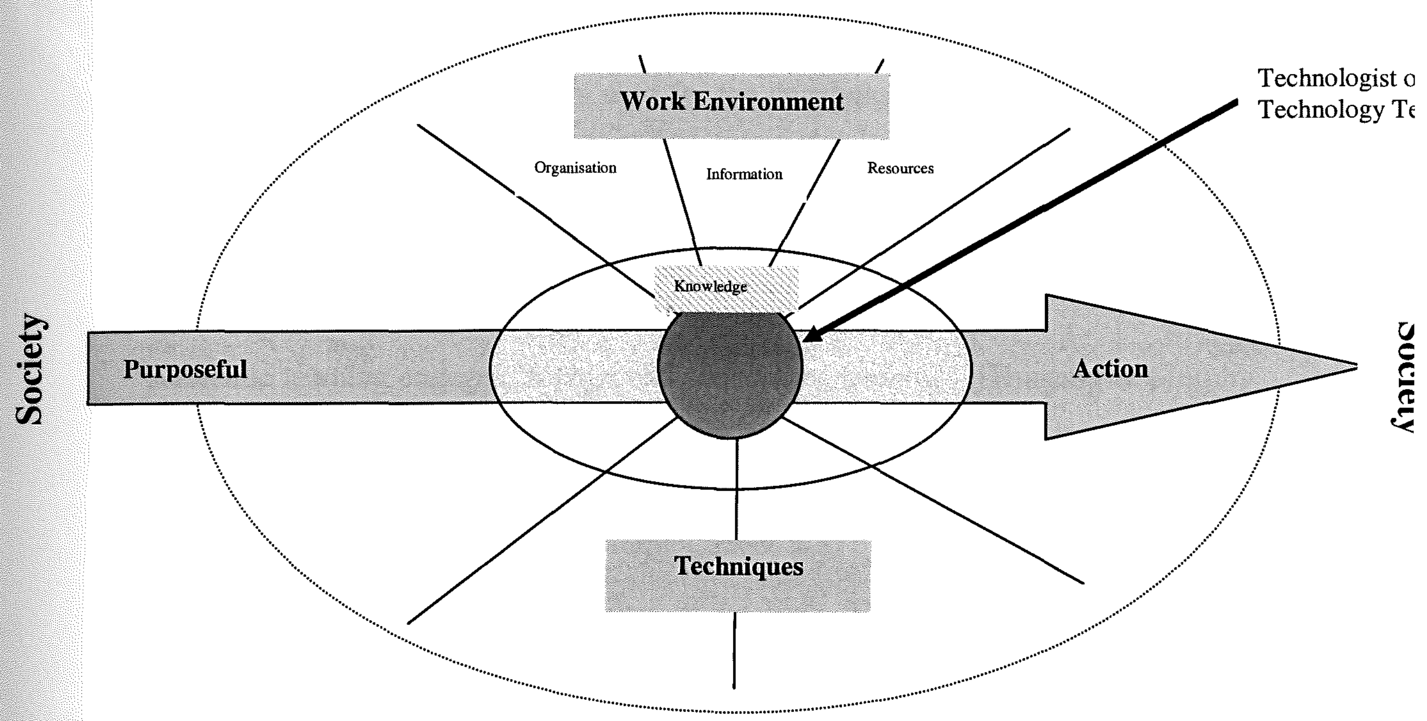
Table 2.4: *Links between Pacey's Model and Technology in the New Zealand Curriculum*

Technology in the New Zealand Strand	Aspects from Pacey's Model	
Organisational Aspect	**Strand A** Technological Knowledge and Understanding	Knowledge of existing economic, political and industrial activity, user and consumer feedback and opinions on existing products
	Strand B Technological Capability	Consumer feedback and opinions in relation to the solution the children are developing
Technical Aspect	**Strand A** Technological Knowledge and Understanding	Knowledge of existing practice, skills and techniques, tools, machinery, chemicals, liveware (living organisms used in technological process), resources, products and waste management
	Strand B Technological Capability	Safe practice and use of skills and techniques , tools, machinery, chemicals, liveware, resources, products and waste management
Cultural Aspect	**Strand C** Technology and Society	goals, values and ethical codes, belief in the process, awareness and creativity

The second model of technological practice is Gawith's model of technology practice (Figure 2.5). This model situates the technologist or technology team within the purposeful action of technological development.

Gawith's model also encompasses the underlying theoretical philosophy that technological practice is holistic, must reflect authentic technological practice and be within the learners' current or possible future field of knowledge. Gawith's model indicates that all technological practice takes place within a social context. The definition for Strand C in *Technology in the New Zealand Curriculum* states "Technological practice takes place within and is influenced by, social contexts" (Ministry of Education, 1995, p. 6). Gawith's model indicates that within society purposeful activity works towards achieving technological solutions. Technologists work through the work environment (this includes knowledge of organisation, resources and information) and research, select and use skills and techniques to action their practice. Knowledge of existing organisation, information and resources has close links to Strand A and skills and techniques are a part of the development of safe practice in Strand B in *Technology in the New Zealand Curriculum.*

Figure 2.5: ***Gawith's Model of Technology Practice (2000)***



The models differ in their representation of technologist practice. Pacey portrays technological practice as static surrounded by each of the three aspects. Gawith's model however, portrays technological practice moving forward with purposeful action towards a desired result. I believe this gives a more accurate picture of technological practice.

Clearly both models recognise there is more to technological practice than just the physical skills of planning and making. Knowledge and understanding of organisation, resources, existing information and existing technologies play a significant role in both models. Both models also place technologists within the centre of their practice with societal influences significant in both. For this reason it is highly desirable that units of work in technology education cover learning experiences from all three strands of *Technology in the New Zealand Curriculum* (Ministry of Education, 1995). This facilitates a holistic approach to technological practice and technology education.

Theoretical Contributions to Technology and the New Zealand Curriculum

The following section introduces seven theoretical perspectives which contribute to and strengthen the argument for the need for an authentic holistic approach to technology education in the classroom. It includes general theory about the acquisition of knowledge, models used for the development of knowledge and skills within a field of practice and theory based on total emersion of the learner in practice.

Authenticity and Current Research

Authentic learning engages children and encourages learning (Hennessy & Murphy, 1999; Rogoff, 1990; Smith, 1999). "Activity is said to be authentic if it is (i) coherent and personally meaningful and (ii) purposeful within a social framework- the ordinary practices of culture" (Hennessy & Murphy, 1999, p.8)

A number of theoretical perspectives that reinforce this belief have influenced the development of the New Zealand technology curriculum document. These are:

- Constructivism (Vygotsky, 1978)
- Expert Knowledge (Bereiter, 1992)
- Anchored Instruction (Vanderbilt Group, 1990)
- The Apprenticeship Model (Rogoff, 1990)
- Enculturation (Brown, Collins and Duguid, 1989)
- Conceptual and Procedural Knowledge (Bereiter, 1992)
- Situated Cognition and Cognitive Apprenticeship (Hennessy, 1993)

Overview

Constructivist theories consider the construction of knowledge within a given framework. An important message about the nature of activities that children undertake is that authentic learning engages children and encourages learning (Hennessy & Murphy, 1999; Hill & Smith, 1998; Rogoff, 1990). Bereiter's theory of learning deals with the concept that different types of knowledge are recognised particularly procedural knowledge. *Expert Knowledge Theory*, *Apprenticeship Models* and *Anchored Instruction* all advocate the use of experts or experienced practitioners as a key component to learning. These theories ultimately lead to the theory of the process of *Enculturation* and the theories of *Situated Cognition* and *Cognitive Apprenticeship* advocate modeling completely within context. Each of these theories is now introduced in more detail to show its link to technology education.

1) Constructivism

Constructivism looks at the individual's ability to make representations within their framework of knowledge. The framework is built up, tested and altered as new knowledge comes to light. By giving students problems authentic to a specific technological culture or practice, they are motivated because of the relevance of and/or a need for their work (Hennessy & Murphy, 1999; Hill & Smith, 1998). Problem solving is an essential part of this process. The knowledge structures in the memory are called schemata. The individual constructs knowledge through experience and instruction (McCormick, 1997). If students are solving problems using practices that are authentic to a specific culture of technological practice their knowledge frameworks are more likely to be stronger as they are able to make connections to real practice and need (Rogoff, 1990).

Constructivist theorists have long perceived that the construction of knowledge occurs through interaction with the environment (Hennessy, 1993; Maddux & Cummings, 1999; Rogoff, 1990; Zuga, 1992). Hennessy (1993) states "it is obvious that merely presenting children with new information and experiences in the classroom is insufficient to promote learning" (Hennessy, 1993, p.11). There is a clear difference between technical studies and/or 'manual training', which were the predecessors of our current curriculum and technology education. Technology education is orientated around the Social Reconstruction philosophy that technical processes or skills should be taught only as the need to know them arises, in order to solve a social problem (Zuga, 1992). This approach is in the process of being implemented by those who advocate technology as problem centred situated learning. Zuga (1999) argues that in order to implement social reconstruction, thoughtful critique of existing practices must be carefully considered.

This has direct relevance to my study because in New Zealand there is a history of technical skills being taught in isolation without a specific need. Prior to 1999 Manual Training was offered to all primary school students in Form One and Two (Years 7 and 8, 11-13 years of age). Students traveled to a local Manual Training Centre where they were offered skills based programmes taught by specialist workshop-metal and woodwork teachers and home economics-textiles and foods and cooking teachers. At Manual Training the students were taught and practised skills through specific projects. For example all children might make a wind chime, a pencil case, date scones or an apron. These projects were predetermined by the teacher and were repeated for succeeding children over a number of years.

Technology education is different in that it involves the students in collaborative participation in problem solving processes to meet identified needs (Ministry of Education, 1995). It is this notion of learning through participation and collaborative thinking processes that is the philosophy of apprenticeships (Hennessy, 1993). In this model skills and techniques are taught to the students when there is a need for them. When the students approach the teacher with a problem or the teacher sees that the students are having difficulty the teacher should facilitate further learning by introducing the students to new skills and techniques that they may not be aware of or are unable to do. This teacher intervention needs to be timely so that the students are not left floundering unaided but not too early so that students maintain ownership of their project. This intervention may also alter student technological practice and increase their chances of developing a successful outcome.

2) Anchored Instruction

Another theory that strengthens the argument for involving students in authentic technological practice within a specific technological culture is the theory of anchored instruction. Whitehead (1929, cited in Situated Cognition Group, 1990) refers to the body of knowledge students have that they don't use unless reminded, as inert knowledge. This is illustrated in the writing of Bereiter (1984, cited in Situated Cognition Group, 1990) who has described a situation where students were given 10 minutes to read an article and learn as much as possible from it. All began reading from the beginning and read until the time was up. Later they acknowledged that they knew about the strategies of skim reading and consultation of headings but did not use these skills spontaneously. A major goal of anchored instruction is to overcome the problem of inert knowledge. This can be achieved when general and specialist knowledge function in a closer partnership. Sound thinking and sound problem solving depend on more expertise than general knowledge. Authentic activities are defined in Vanderbilt (1990) as "ordinary practices of culture" and anchored instruction tasks are described as projects that simulate apprenticeships, comprising of authentic tasks (Situated Cognition Group, 1990). Practice of these theories should maximise the use of expert knowledge by stimulating the use of inert knowledge.

3) The Apprenticeship and Cognitive Apprenticeship Models

The apprenticeship model of learning involves the successful modeling of expert practice. The notion of apprenticeship is that the learner is initially in a position where observation of an expert is extensive and over time the learner does more and more while the support of the expert is slowly withdrawn as the learner becomes more proficient at the task (McLachlan-Smith, 1998). The aim is to give the learners control over their own learning and to engage them in critical analysis. The expert begins by modeling effective strategies or making explicit their tacit knowledge. Vygotsky (1962, 1978 cited in Hennessy, 1993) referred to the help, which thereby enables the learner to engage in the activity with increased confidence and competence as 'scaffolding'. The critical factor is for the provision of authentic dilemmas, in the classroom these may be real or imaginary (Lave, 1992). Furthermore Hennessy (1993) states teaching of technology must reflect the real world of technological activity and must be informed by technology as it is actually practised.

Cognitive Apprenticeship (Hennessy, 1993) methods of learning aim to enculturate students to authentic practices through activity and social interaction (Rogoff, 1990). Vygotsky (1978) stated that the "zone of proximal development" involved students and teachers in dialogue about knowledge they have and knowledge they need. Vygotsky believed that learning and development combine in a complex interrelated fashion. There is a difference in the learning of a child that occurs independently and that, which occurs in conjunction with another person (Berk & Winsler, 1995). The gradual withdrawal of help as the learner's participation increases is called 'fading' (Hennessy, 1993). Cognitive apprenticeship programmes assist students through situated learning, enabling students to observe, engage and invent or discover strategies in context (Hennessy, 1993; Johnson, 1992; Rogoff, 1990).

> Invention, discovery and refinement of problems are the hallmarks of the most successful instructional programmes. Problems should be ones pupils want to solve, which are real and relevant to them, which engage their interest, and for which they can take responsibility. Problem solving now comes to denote the resolution of meaningful problems and dilemmas in the context of guided social interaction and negotiation with teachers and pupils (Hennessy, 1993, p. 33).

Johnson (1992) also compares cognitive apprenticeship with traditional apprenticeship. "Cognitive apprenticeship uses many of the instructional strategies of traditional apprenticeship but emphasises cognitive skills rather than the physical skills. Traditional apprenticeship contains three primary components: modeling, coaching and fading." (Johnson, 1992, p.4). One of the strengths of apprenticeship is the importance of real activities, which are performed by the expert and copied by the learner. Cognitive apprenticeship uses these same strategies but during the coaching stage the expert shows the students how to complete the tasks or solve the problem while verbalising the activity. In contrast to many current school models the instruction occurs with a real context. The student learns about the complexity of the expert's thinking, that they make many mistakes and take many changes of direction in their thinking during the problem solving process (Johnson, 1992; Rogoff, 1990). Johnson gives this example:

> If a lesson deals with the concept of recycling, an activity for students should be designed around a real problem such as the development of a community-recycling programme. As an introduction to this lesson, the instructor should work through a similar problem with the class to model the thinking processes to be used. (p. 4).

In addition to the three phases mentioned above lessons in this model should increase with complexity and diversity and providing an environment to promote intrinsic motivation, cooperation and competition. (Collins et al. as cited in Johnson, 1992).

4) Expert Knowledge

Technology has a great potential to enable children to solve problems in authentic situations and so participate in active and reflective activities. The development of expert knowledge comes from the persistent solving of problems in relevant domains (Bereiter, 1992). "Technology Education is concerned with complex and interrelated problems that involve multiple variables that are technical, procedural, conceptual and social" (Hansen & Froelich, cited in Jones, 1996, p.1). This quote from Hansen and Froelich is an early reference to the knowledge domains identified by the LITE team and reinforces the need for a holistic approach to technology education in the classroom.

5) Enculturation

Enculturation is the process by which a person moves into and becomes part of an existing culture. The culture is defined in terms of the way in which people behave in any given context. Thus it is argued that technological development happens within the given culture of the company or process. Activity, concept and culture are all interdependent and learning must involve all three (Brown, Collins, & Duguid, 1989; Lave, 1998). Too often students have been asked to use a tool in isolation without links to the real world culture of the practice. The culture of a practice determines the way a practitioner uses a tool. To learn to use a tool as a practitioner does, a student, like an apprentice, must enter the community and its culture. Successful learning then becomes a process of enculturation (Brown et al., 1989; Rogoff, 1990). Brown, Collins and Duguid argue that learning should be a process of enculturation. However, this is problematic because most school activity is very different from the activity of practitioners.

> When authentic activities are transferred to the classroom, their context is inevitably transmuted; they become classroom tasks and part of the school culture.... Consequently, contrary to the aim of schooling, success within this culture often has little bearing on performance elsewhere (Brown et al., 1989, p.34).

Therefore, in order to increase authenticity in student technological practice I argue students need to be aware of and immersed in the culture of existing practice as much as possible.

6) Procedural and Conceptual Knowledge

Bereiter's (1992) theory of learning deals with the concept of procedural knowledge. He considered there to be two types of knowledge: declarative knowledge (knowledge of things) and procedural knowledge (knowledge about processes and sometimes skills). McCormick (1997) has also identified two types of knowledge: 'Know How' (procedural knowledge) and 'Know That' (conceptual knowledge). Both of these theories are relevant to the notion of authenticity. Procedural knowledge includes knowledge of design processes, problem solving and strategic thinking. It also includes knowledge and use of technological principles within context (McCormick, 1997). Procedural knowledge is a major component in successful learning in technology. On the other hand conceptual knowledge includes knowledge of facts, not in isolation but as part of an active process. This active process must be a part of the enculturation process mentioned earlier. Conceptual knowledge can cause problems in technical activities because of a lack of knowledge transfer (Jones, 1996). The transfer of knowledge is the ability to learn in one area and apply that knowledge in another curriculum area (McCormick, 1997). It is my experience from teaching technology in the classroom that knowledge transfer does not happen naturally. I hold the view that teachers should teach transfer by indicating to students the learning they need to use elsewhere and its application. This is because understanding and awareness of procedural knowledge can encourage children to transfer knowledge and skills that may be common to a number of different units. Such an awareness of process means they are able to make links between what they have done and are doing and are going to do.

7) Situated Cognition

Theories that strengthen the argument for technology programmes to reflect authentic technological practice include the theory called *Situated Cognition*. This theory highlights the issue of the difference between traditional classroom learning and learning within practice. To further understand the importance of learning within authentic practice there is a need to comprehend knowledge acquisition and investigate the difference between the knowledge of novices and experts. Hennessy (1993) contends "Learning is most successful when embedded in authentic and meaningful activity, making deliberate use of physical and social context" (p.34).

Situated Cognition encompasses thinking as a part of a culturally organised activity carried out within a community of practitioners (Rogoff, 1990). Learning is deemed to be more successful when it is embedded in authentic and meaningful activity, which makes use of the physical and social context. Therefore schools would be wise to change their activities if they differ from activity that children and people would engage in elsewhere (Lave, 1998; Stein, McRobbie, & Ginns, 2001). The Model of *Situated Cognition* is advantageous for technology education. Where students are given authentic opportunities to measure, speak, write reports, discuss and consider social, environmental and health issues, Lewis (1999) contends these provide useful models across all curriculum areas. "In the process of studying technology and learning technological concepts, other areas of the curriculum become more accessible" (p.3).

This practice differs from what is considered to be accepted classroom practice. For example,

- in schooling individual knowledge and achievement are the norm. Emphasis is placed on individual achievement, even within group work. Individuals are usually assessed as individuals and therefore not really encouraged to work socially
- incentives outside school lead to learning that is self-motivated or commercially driven. Problems encountered are authentic and relevant to the learner rather than those artificially constructed
- intellectual and emotional factors are separated in formal learning but fused in a more informal setting
- outside a school setting problems are multi-faceted and solutions need to be defined before they can be investigated. At school, however, problems are usually pre-formulated and given with appropriate data

- at school external tools are sometimes purposefully excluded but in the real world the success of a problem solving exercise may well depend on the external tools being available (Hennessy, 1993).

I believe that technology has the potential to break down some of these differences and thus provide a lead for other curriculum areas in the field of authentic practice in the classroom.

The theories mentioned above have informed the development of the technology curriculum. More recent research has focused on the aspects of classroom delivery and assessment of technology.

Relevant Current Research

Learning in Technology Education (LITE From Formative to Summative Strategies in Technology Education)

The LITE research has guided my understanding of technological practice in schools. In particular it has highlighted the importance of conceptual and procedural knowledge for planning, implementing and assessing quality programmes of work.

The LITE Research project carried out though the University of Waikato from 1998-2000 established a framework of knowledge domains to enhance the learning and teaching of technology education (Jones & Moreland, 2001). These domains are:

- *Conceptual knowledge* is the knowledge and understanding of relevant technological concepts and procedures. A concept is an idea of a class of things that are linked through common key characteristics or understandings. For example the concept of 'feline' could mean arched back, raised hair, scratching and hissing

- *Procedural knowledge* is knowing how to do something, what to do and when to do it. Investigation, research, design, communication and evaluation processes are fundamental to technology education. Knowledge of how, when and why to implement and undertake these process is procedural knowledge

- *Societal knowledge* involves aspects related to the interrelationship between technology and groups of people. This involves an understanding of the impacts technology has on society and how people influence technological development directly and indirectly

- *Technical knowledge* is the skill and knowledge related to the manual or practical techniques considered and /or used for the selected technological practice.

Jones and Moreland (2001) contend that it is desirable to work across all these domains in order to enhance children's learning. The LITE research investigated emerging classroom practice, intervention strategies, conceptual, procedural, societal and technological learning outcomes and the development of models for summative assessment in technology education with Years 1-10 children over a three year timeframe in New Zealand. The following three headings are those given to the three years of research.

Existing Practice 1998 Year One

In the first year the teachers attempted teaching technology in the full range of technological areas and strands. Technological Capability, Strand B from *Technology in the New Zealand Curriculum* (Ministry of Education, 1995) had the most weighting in their actual classroom practice. It was found that teachers had difficulty in identifying procedural and conceptual knowledge needed for the unit. All attempts by students were accepted without discrimination and they were not required to reflect on their work to determine whether they had met the requirements or not, or discuss how well they had met the objectives and what they might do next. It was found that opportunities to build on relevant conceptual, procedural and societal aspects were lost and the students often confused the main purpose of the task, believing that social and managerial aspects (e.g. cooperation and behaviour) were more important (Moreland et al., 2001)

Enhanced Formative Assessment 1999 Year Two

The focus of the second year was to enhance teachers' conceptual and procedural aspects with movement from general concepts to specific concepts within different technological areas. Teachers learned to identify specific technological learning outcomes for the first time and developed understanding of conceptual and procedural knowledge to enable them to write specific learning outcomes. There was a shift in focus from providing learning experiences to providing opportunities for students to achieve identified specific learning outcomes. The teachers became focused on the students' technological learning and more emphasis was placed on providing feedback and assistance to the students to develop particular technical skills. There was also an emphasis on conceptual and procedural skills rather than social and managerial skills which meant that more precise formative interactions enhanced student learning (Moreland et al., 2001).

The two-year research showed that teachers being very clear about learning outcomes, particularly at the planning stage gained a positive effect on student learning.
Early articulation of intended learning outcomes assisted teachers to:

i. clarify the technological knowledge they needed to teach
ii. make strategic decisions in their classroom
iii. provide direction for student learning
iv. carry out effective formative interactions (Moreland et al., 2001).

Development of Summative Assessment Models 2000 Year Three

In the third year of the project the research team focused on the use of models to enhance teacher technological knowledge as a means to improve formative interactions and summative assessment. The models introduced to the teachers were structured to help them profile their students in terms of the domains of technology mentioned above. This led to the identification of two key factors in assessment of technology education; that meaningful assessment should be an integral part of teaching and learning and that classroom-based assessment has a central role in the promotion and enhancement of student learning and achievement. This is widely accepted both within New Zealand (Crooks, 1988; MOE, 1993 and 1994: Bell and

Cowie, 1997: cited in Moreland et al. 2000) and internationally (Gipps, 1994: Black, 1998: and Black & William, 1998: cited in Moreland et al. 2000).

This study has highlighted the need for clear understanding of the key processes and concepts of assessment in this new curriculum area. The next section discusses assessment in technology education and the place and value of authentic assessment for students.

Assessment in Technology Education

Assessment in technology differs significantly from other curriculum areas. Assessment in technology must be based on technological practice and therefore requires a holistic approach. Some assessment strategies are more suited to the assessment of authentic technological practice than others. Many traditional methods of assessment used in schools are not suitable for the technology area which raises further issues for teachers.

Authentic Assessment

It is very clear from the previous section that technology education is most effective when taught within authentic technological practice. It follows that effective assessment of technology education should also be authentic. Technology in the New Zealand curriculum states:

> Assessment of technology education is more than the assessment of the individual components: rather the whole task or outcome should be evaluated. Emphasis on a narrow component or testing outside the context of learning does not enable reliable judgments to be made. Nor do single-focus standard assessment tasks, designed to rank or assess students in relation to levels, meet the purpose outlined above (Ministry of Education, 1995, p. 24).

The aim of assessment is to educate and improve student performance and teaching (Freeman, 1998; Wiggins, 1998). For assessment to be of true value there are two levels that need to be addressed. Firstly assessment should be designed to teach students by providing models to reveal to the students what worthy adult work looks like (authentic tasks) rather than **just** measuring their performance. Tasks need to be realistic and credible which in turn engages the students. Assessment needs to be open with clearly stated criteria and/or standards, which are known to the students and their teachers. Secondly assessment should provide rich useful feedback to the students (and their teachers in the case of external assessment) and feedback needs to be timely and ongoing (Wiggins, 1998).

Assessment is authentic when we anchor testing in the kind of work real people do, rather than merely eliciting 'easy-to-score' responses to simple questions. Authentic assessment is true assessment of performance because teachers thereby learn whether students can intelligently use what they have learned in situations that increasingly approximate adult situations, and whether they can create innovative new situations. The reasons that assessment must be anchored in and focused on authentic tasks are because they supply valid direction, intellectual coherence, and motivation for the day-in day-out work of knowledge and skill development (Stoll & Fink, 1996; Wiggins, 1998).

In quality educative assessment (Wiggins, 1998) students have a clear understanding of what they want to learn. As well they need to be told very clearly how they are to demonstrate their learning. Using this method of assessment students are able to accurately self assess their work regardless of their ability (Wiggins, 1998). Assessment should no longer be a test after the learning and teaching is over but on-going involving performance, feedback, evaluation which allows students to self assess and self correct their work to a high standard (ibid.). Assessment must be overt to students. Learning objectives must have clearly stated assessment criteria and be shared (Compton & Harwood, 1999; Sutton, 1995). Involving students in the assessment process is about teachers using small progressive steps in the pursuit of more effective learning (Sutton, 1995).

In technology the nature of the technological practice should reflect the degree of authenticity in practice. One of the difficulties is that total authenticity is not always practical, especially in a primary classroom. Children do not have the skills, equipment or understanding to be completely authentic, but their process should be able to reflect authentic practice even if the content of the process differs from the real thing. Despite this difference, the initial research, designing and modelling process should be very similar to actual practice. However, there will be times in the classroom when the children will be unable to complete aspects of practice because of safety or lack of physical or cognitive development. As in 'real' practice this work can be given to experts to do. Children still benefit because they are making decisions and have control over their designs.

Formative Assessment

LITE research (Moreland et al., 2001) has identified several key features of formative assessment which relate to student learning. The core of formative assessment is the perception by the learner of the gap between a desired goal and his or her present state and the action taken by them to close the gap in order to attain the desired goal. An awareness of the gaps provides a guide for further learning. The apprenticeship model of learning allows students to clearly identify the differences between themselves as the learner and that of the expert. The LITE research team identified that students do not make progress through what they don't know but through extending what they already know. It is necessary for teachers and students to look for strengths within individual students. Quality teacher feedback is vital. For feedback to be effective it must be specific and focused on the identified learning outcomes. When teacher feedback is focused on the promotion of social and managerial feedback it draws the students' attention from the task and this may have a negative effect on learning. Formative interactions between teachers and students become distorted if there is a lack of subject knowledge and how the students construct technological knowledge (Moreland et al., 2001). I acted on these findings in my own study where I offered teachers a professional development day to increase their knowledge and skills in technology education and based this on LITE findings. Like the LITE Research Project I identified three dimensions of knowledge required by teachers:

i. Knowledge about technology
ii. Knowledge in technology and general technology
iii. General technological pedagogical knowledge

Summative Assessment

The LITE research has also identified several key principles of summative assessment which relate to student learning. Summative assessment provides an overview of previous learning and an accumulation of evidence collected over time. Summative assessment also assists teachers and learners in decision making about future learning. To be effective it must have:

i. a shared structure and language
ii. adequately detailed information
iii. a common criteria for grading
iv. a shared procedure for determining standards
v. clear and agreed documentation
vi. an interplay between reliability and validity. A high level of shared understanding between teachers can increase this (Moreland et al., 2001).

Summative assessment judgments in technology become more difficult to make in a new subject area where there is a lack of shared subculture on the nature of the subject, lack of practical classroom experience and tenuous technological summative assessment structure (Moreland et al., 2001). However, because there are a number of assessment tools/ strategies that are suitable for the holistic nature of assessment in technology and these allow assessment of authentic technological practice. Portfolios are one of these.

Portfolios

Portfolios are an essential part of assessment in technology education and an accepted tool for formative and summative assessment. An individual portfolio should show a progression of learning within or across topics and can be useful for involving parents as well as students. Relevant material from individual portfolios may be used to build up a class portfolio. As well as showing progress of learning within or across topics it should be useful for succeeding teachers and may show progression. Portfolios may become useful tools for teachers to make judgments about where students are placed and where they might take them. LITE (Assessment) considered portfolios should:

- reflect their planning and assessment models
- include learning outcomes
- include relevant student and teacher commentary
- include samples of work to back up commentary as well as further analysis
- to be meaningful to the readers for whom they are intended
- contribute to accountability requirements; and
- above all, improve student learning (Moreland et al., 2001).

Clearly with these aspects as a part of a portfolio, technological process and practice can be both a visible and an authentic assessment tool.

Issues of Assessment

The purpose of assessment is to monitor students' progress primarily with a view to improving learning and teaching. Assessment in technology is of value when it enables students to be immersed in authentic technological practice (Turnbull, 2002). It also involves the four domains of knowledge identified by LITE research carried out by Jones and Moreland (2001). Learning is of most value when all aspects are included.

Kimbell (1997) very neatly identifies one of the key issues of assessment in technology education. Fundamental to technology education worldwide is the process of design and development rather than there being a body of knowledge and skills as in other curriculum areas. While practical knowledge and skills can enhance this process it is the assessment of students' capability in design and the development of tangible outcomes which meet identified needs which are more complex than the assessment of their knowledge and skills. Thus technology education is considered to be leading the field in process-based assessment (Kimbell, 1997).

Progression, and what to assess, are also important issues in technology. Understandings of formative and summative approaches of assessment and an understanding of the technology curriculum are needed to provide valid information about progression in technology education. Progression in technology is defined in the four domains which have been introduced earlier in this section. Progression in student technological practice will include both generic and specific aspects of technology (Moreland et al., 2001).

Authentic Assessment Tasks

Wiggins (1998) suggests that authentic assessment tasks are realistic when they replicate the ways in which the knowledge and abilities are "tested" in the real world. Authentic tasks also require skills of judgment, innovation and negotiation of the task to be assessed. Finally authentic assessment allows for appropriate opportunities to rehearse, practise, consult resources, and get feedback on and refine performances and products.

In judging the authenticity of assessment tasks Archibald and Newmann (cited in Burke, 1999; Wiggins, 1998) have developed three standards. These require:

- disciplined inquiry
- construction or integration of knowledge
- value beyond school/ evaluation.

Disciplined inquiry depends on the students' prior knowledge and the understanding the student has of the problem. Disciplined inquiry gives students the power to respond to and sometimes reject the public knowledge base (Burke, 1999; Wiggins, 1998).

Integration of knowledge and construction of knowledge refers to the higher order of thinking (synthesis, analysis and evaluation levels of thinking in Bloom's taxonomy). This allows consideration of the whole rather than fragments of knowledge. Tests have shown that students often memorise short answers but have few ideas about how these answers fit into the bigger picture. Students need to be involved in the production of new knowledge rather the reproduction of existing knowledge.

The last criterion for authentic achievement is the *value the learning* has in the real world. It is necessary to connect learning to the world, involving audience beyond the classroom and school (Wiggins, 1998). At the same time the authentic assessment process should be unobtrusive to teachers and students and seamless with teaching and learning.

Wiggins (1998) also suggests that authenticity is a matter of degree. Tasks, which are not authentic, may include the explanation of data, the recall of laws or the reading of a teacher selected text. Tasks which Wiggins describes as 'somewhat realistic' may include for example the design of a house using specific mathematical formula and shapes or writing a persuasive essay on why a law should change or the reading to the class of a self-selected book or text. Authentic tasks for the above examples may include the designing and building of a model house which meets client demand and legal standards and writing a proposal to present to legislators to change a current law or the making of an audio-tape of a story for the school library. While tasks may not always be practical and hands-on they should allow replication of how people might meet challenges and solve problems in the field.

There are very clear differences between authentic tasks and their traditional predecessors. The differences between traditional school testing and authentic tasks are indicated in Wiggins (1998, p.23), see Table 2.6.

Table 2.6: ***Key Differences between Typical Test and Authentic Tests***

Typical Tests	Authentic Tasks	Indicator of Authenticity
Require correct response only	Require quality product and/or performance and *justification.*	Assess whether the students can explain, apply, self adjust, or justify answers, not just the correctness of answers using facts and algorithms.
Must be unknown in advance to ensure validity	Are known as much as possible in advance; involve excelling at predictable demanding and core task; are not "gotcha!" experiences.	The tasks, criteria, and standards by which work will be judged are predictable or known-like the recital piece, the play, engine to be fixed, proposal to a client, etc.
Are disconnected from a realistic context and realistic constraints	Require real-world use of knowledge: the student must "do" history, science, etc. in realistic simulations or actual use.	The task is a challenge and a set of constraints that are authentic- likely to be encountered by the professional, citizen or consumer. (Know How, not plugging in as required).
Contain isolated items requiring use or recognition of known answers or skills	Are integrated challenges in which knowledge and judgment must be innovatively used to fashion a quality product or performance.	The task is multifaceted and non-routine, even if there is a "right" answer. It thus requires problem clarification, trial and error, adjustment, adapting to the case or facts at hand etc.
Are simplified so as to be easy to score reliably	Involve complex and non-arbitrary tasks, genres, and standards.	The task involves the important aspects of performance and/or core challenges of the field of study, not the easily scored; does not sacrifice validity for reliability.
Are one shot	Are interactive: contain recurring essential tasks, genres, and standards.	The work is design to reveal whether the student has achieved the real versus pseudo mastery, or understanding versus mere formality, over time.
Depend on highly technical correlation	Provide direct evidence, involving tasks that have been validated against core based adult roles and discipline- based challenges.	The task is valid and fair on its face. It thus evokes student interest and persistence, and seems apt and challenging to the students and teachers.
Provide a score	Provide useable, diagnostic (sometimes concurrent) feedback: the student is able to confirm results and self adjust as needed.	The assessment is designed not merely to audit performance but to improve future performance. The student is seen as the primary "customer" of the information.

(Wiggins, 1998, p. 23)

Problems for the Assessment of Student Learning

Wiggins (1998) states that traditional test items try to measure performance by sampling content knowledge. In preference to this, tasks should assess students' ability to perform tasks at the core of each curriculum area, and use scaffolding where needed for novice learners in the same way 'T Ball' scaffolds learning for baseball and softball.

One reason educators sometimes think they cannot provide learner centred assessment is the lack of time (Sutton, 1995; Wiggins, 1998). This is like saying there is no time to travel to play another team in soccer because they have to get through the soccer curriculum. Or not enough time for a music recital because only a few pieces will be covered. Assessment must anchor teaching and because it facilitates quality learning, time must be made for it (Wiggins, 1998).

I believe authentic assessment tasks are the key to meaningful and valuable assessment. Assessment within an authentic context will motivate children to move forward in their learning.

In this chapter I have discussed the holistic nature of technology education and the need for assessment that is authentic and a part of students' technological practice. Technology education is a comparatively new curriculum area and its structure is significantly different to other curriculum areas in the New Zealand Curriculum Framework. Enhanced teacher knowledge was highlighted by the LITE research as a key factor in the development of quality learning for students in technology education. The best way to ensure that teachers understand and act on this is through quality professional development.

Professional Development in Technology Education

Technology has been identified as a distinct learning area by the Minister of Education since 1991 and is one of the seven essential learning areas. Here specific knowledge and skills are noted to demonstrate the relationship between technology and society and how they impact on each other. However, the issue concerning the implementation of technology education is the complexity of addressing content knowledge in a way that helps teachers to teach technology as skills, content and processes. Professional development programmes need to grapple with teachers' content and process knowledge (Chamberlain et al., 1999). This aspect links to Stoll and Fink's (1996) 'what' dimension of technology. Another dimension to consider in professional development programmes is how to promote and facilitate teacher change. This is the 'how' dimension.

I argue that the main difficulty with the teaching of quality technology education in New Zealand is that currently teachers are required to teach a curriculum that most have never experienced and many have experienced little or no professional development. Effective professional development programmes in technology education are essential. Several themes are important for this. These are **technological knowledge** and **openness to change** and the ability to use the knowledge and skills **independently** (Stoll & Fink, 1996). These themes are vitally important in the process of improving the quality of technology education delivered in New Zealand schools and are explored in the following section.

Professional Development Theory

Professional development and teacher education in technology have been the focus of much discussion since the formative beginnings of technology in the 1980s. McGee (1997) stated that teachers should be at the forefront of curriculum decision making. He argues teachers need to be engaged in regular and on-going professional development which can occur at various levels: national, regional or school and classroom.

Successful professional development must promote teachers' capacity to become independent in their new knowledge and skill acquisition. (Fullan, 1991). Three contributions to successful professional development are provided - the way of know how, the way of independence and the way of role accommodation (Fullan and Hargreaves, 1991). The writers purport professional development involves much more than imparting knowledge and skills to teachers. Teachers must be able to see the relevance of the material offered, which in turn will encourage them to continue to use their new found skills and knowledge beyond the support offered.

Stoll and Fink (1996) suggest that change for teachers involves three aspects; the first is relevance of the improvement, second is the readiness of the staff to be involved and the third is the availability of resources and support. However, Hoyle and Megarry (1980) identify three barriers to effective professional development programmes; lack of resourcing and structure, the nature of schools as a social system and the work situation of teachers. School improvement is unique within each school because of differing contexts. There is clearly a link between Stoll and Fink's (1996) aspects and the barriers cited by Hoyle and Megarry (1980). The nature of schools as a social system can be linked to all three of the required aspects. Schools with collaborative and cooperative approaches are more likely to have staff who are well informed and who can see the relevance of work to be done. The readiness of the staff to be involved in professional development may also be clearly linked to their work situation, where over worked and stressed teachers may be more likely to resist change if it means further work or stress for them. Resourcing is possibly the most obvious of these links. The availability of resources will clearly have a direct link to the quality of programmes offered.

Teacher development involves more than changing teacher behaviour but involves changing who the teacher is and their beliefs. A change in behaviour may precede the change in belief (Hargreaves & Fullan, 1992). Teachers need to see new approaches working and clearly linked to classroom success. Successful new approaches are more likely to be adopted by teachers, thus continuing forward momentum. Stoll and Fink (1996) define school improvement as a series of on-going processes which include:

- enhancement of pupil outcomes
- a focus on teaching and learning
- a capacity to take charge of change
- definition of own direction
- assessment of current culture
- strategies for achievement of goals - this is the advantage of a facilitator modelling and/or working along side
- addressing internal conditions that enhance change
- maintenance of momentum in tough times
- the monitoring and evaluation of practice.

Internationally, recent approaches to teacher development have been school based because this allows teachers to be directly involved in decision making shaping the approaches made (Hargreaves & Fullan, 1992). This enhances their commitment and ownership of learning.

Lifelong learning through continuous professional development is a key message given by Stoll and Fink (1996) in their book *Changing Our Schools.* Much of this learning is school based but at times school practitioners and other partners are invited to present courses. For classroom based professional development to be successful teachers must: recognise that they are **co-learners** with their students, recognise that their development is **based in the classroom**, make **practical changes** but also have a personal, educational and social priority and participate in reflective and collaborative experiences to empower student and teacher interaction (Hargreaves & Fullan, 1992). Ramsay (1990, cited in McGee, 1997) suggests there are three characteristics that are linked to teacher willingness to change which are an openness to new ideas, a willingness to share ideas with colleagues and parents, and preparedness to take risks.

Three models of professional development, Joyce and Showers (1995), Fullan (1991) and Lewinian model of Experiential Learning (Kolb, 1984) are particularly relevant to the professional development undertaken by the teachers in my project. These models enabled me to plan a professional development programme to maximise the likelihood of changing the teachers' approach and practice in technology education taking into consideration the time constraints of the project. They suggest that professional development is more successful when it is on-going rather than a one-off session. These models also found that it was beneficial when teachers had the opportunity to change their practice by implementing new ideas in a supportive, collegial environment.

In the first model, Joyce and Showers (1995) claim new knowledge is best acquired when it includes the following different components:

- theory about the topic
- live and mediated demonstration or modeling of new skills
- opportunities for practice
- feedback

- further coaching.

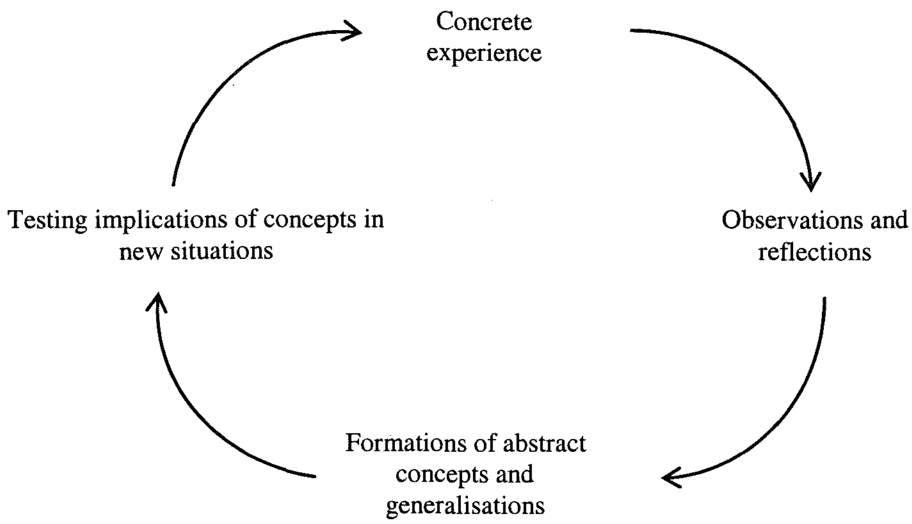
Fullan (1991) identifies three stages in the process of curriculum change (Figure 2.7). The *initiation* phase includes the identification of the curriculum area and the associated questions. *Implementation* involves teachers working with an outside facilitator to determine strategies and develop a plan of action. The facilitation phase involved the teachers working with a facilitator to enhance their understanding of the relevant knowledge base. Teachers are encouraged to share their ideas and need to feel a sense of ownership. Finally the *continuation* phase puts the two previous phases into practice with the hope that new practice the desirable *outcome* will emerge (Fullan, 1991).

Figure 2.7 ***A Simplified Overview of the Change Process (Fullan, 1991, p. 48)***

Initiation ⟷ **Implementation** ⟷ **Continuation** ⟷ ***Outcome***

The Lewinian Model of Experiential learning emphasises the central role of experience (Kolb, 1984). Classroom based teacher professional development is an orientation which situates the professional growth of the teachers within the daily realities of their classroom (Hargreaves & Fullan, 1992). Kolb (1984) suggests that experiential learning theory offers a holistic perspective on learning that combines perception, cognition and behaviour. It is this holistic approach that situates comfortably within technology education. Not only are teachers allowing their students a holistic approach to their technological practice but modelling it in their own approach to professional development. Teachers see the pay-off when witnessing the excitement of the pleasure of learning. Figure 2.8, the Lewinian Model of Experiential Learning indicates a cyclical approach to experiential learning with a balanced approach between theory, practice, assessment, reflection and evaluation (Kolb, 1984).

Figure 2.8 ***The Lewinian Model of Experiential Learning (Kolb, 1984)***



New Zealand Models of Professional Development Used for the Implementation of New Curricula

A number of different models of the professional development of teachers were used in New Zealand from 1995-1998 for the implementation of the new curricula. The selection of model depended on the format proposed by the contractors selected to deliver the contracts. The three models most commonly used were either:

- *individual teacher approach* - aimed at individual teachers to heighten teachers' understandings of the curriculum document and present ideas for classroom implementation
- *lead/key teacher approach* - involved the selection of a group of key teachers from the participating schools who undertook the professional development programme and then had the responsibility to co-ordinate development programmes for other members of their school staff and community
- *whole staff approach* – aimed at giving the whole school the same message through a programme and activities lead by an external facilitator (Dewar & Bennie, 1996).

Dewar and Bernie (1996) in their evaluation of professional development programmes delivered in New Zealand in 1995/1996 and Scott and Murrow (1998) in their evaluation of programmes delivered in 1996/1997 reported that over 80% of teachers found programmes offered using these three models were either effective or very effective.

In 1996 I participated in two technology contracts, one using the individual approach and the other using the whole staff approach. In 1997 I facilitated a contract using the lead/key teacher approach. I have therefore had first hand experience of all three of these approaches of professional development in technology education.

Requirements for Technology Education Professional Development

Chamberlain et al. (1999) report in *Implementation of Technology in the New Zealand Curriculum* six key findings in their evaluation of implementation programmes. These are that :

- strong leadership at school level is important
- strategic planning for implementation makes a difference
- full implementation takes time
- schools have a strong desire for guidance, along with materials and resources
- in technology teachers are least confident about assessment and monitoring
- professional development is an on going process.

This supports Compton (cited in J. Burns, 1997) who stated that schools should determine their own implementation plan for the introduction of technology and McGee (1997), mentioned earlier, that teachers should be at the front of curriculum decision making. One of Fullan's (1993) eight basic lessons of the new paradigm of change is that **both** the top-down and the bottom-up strategies are necessary for change to occur successfully. This means that not only do the teachers need to be fully involved and motivated but directives from management/government should support and guide development.

Implementation of this Project

The model I used for the professional development of the teachers in this project was the *individual teacher* approach. This was because of the schools' strong desire for guidance, my ability to provide materials and resources, a lack of teacher confidence in assessment and monitoring children's progress and the need to make professional development an on-going process. Other reasons were that the study was limited in size and funding so I elected to work with only one teacher from each school to ensure a wide socio-economic coverage and that teacher guidance, increased teacher confidence and sustainability of new skills were the foci of my work.

The following paragraphs explain how the work I did with the teachers on this project reflected the theoretical models of professional development presented earlier in this chapter. The individual approach simply means that I worked with one teacher from each school; there was no expectation by me for the teacher to then pass that information on to others in their school community. My main aim was to increase the individual teacher knowledge and understanding of technological practice, develop technology unit planning, teaching and assessment skills.

The Joyce and Showers Five Step model (see Figure 2.9) offers components that are important for the teachers' development. Teachers in this project were introduced to new concepts of theory. They witnessed my modelling of the unit planning and writing process. The teachers and I (in the role of mentor) then collaboratively planned a unit of work. The unit planning process included the development of a Knowledge Identification Sheet (KId. sheet, see Appendix Eleven). The KId. sheet ensured that all four knowledge domains identified by the LITE research team were included in the unit plan at both specific and generic levels. The unit plan (see Appendix Ten) was written after the development of the KId. Sheet with cross referencing to ensure all essential knowledge was included in the learning experiences undertaken by the children. In this project rather than just giving the teachers a unit to be taught, or collaboratively teaching a unit planned by me we spent considerable time discussing the knowledge domains and took time to identify the necessary knowledge. As the teachers practiced these skills and implemented them in the classroom they moved closer to a level of independence. Throughout this stage there was continuous dialogue with me which included feedback and future ideas. Ideally I would have liked the support offered to my teachers to continue throughout the year to guide them in a more independent approach to planning and teaching technology, however this was not possible because of time constraints.

Diagram 2.9 ***An Overview of the Change Process in this Project (Joyce and Showers, 1995).***

Steps	**This Project**
Theory about the topic,	Introduction to LITE research and knowledge domains
Live and mediated demonstration or modeling of new skills,	Modelling of the unit planning process and co-operative unit writing
Opportunities for practice,	Co-facilitation of the unit in the classroom
feedback and further coaching.	Discussion and on-going feedback to the teacher throughout the teaching of the unit

Fullan's model also informed my approach to teachers. It is more focused on the practical aspects of professional development. To **initiate** the study we began the session with an introduction to LITE (Moreland et al., 2001) theory and the Pacey (1983) and Gawith (2000) models of technological practice. During **implementation** of the unit teachers also had my full support in their classrooms through a team teaching approach. The teachers' **continuation** step was to then move out of their comfort zone and take a risk by planning and teaching a technology unit independently for the first time. A desirable ***outcome*** occurs when teachers move to independent and active understanding of the process. Figure 2.10 shows how my approach fitted Fullan's model.

Figure 2.10 ***An Overview of the Change Process in this project (Fullan, 1991)***

Initiation	↔	**Implementation**	↔	**Continuation**	↔	***Outcome***
An introduction to LITE research and unit planning process using knowledge domains		Teachers experiencing the practical activity to be completed by the children, writing of the knowledge identification sheet and unit plan		Putting the theory and practice together by team teaching the unit in the classroom and reflecting on the learning that has occurred		Skills for independent identification of knowledge and unit planning process based on knowledge and skill content

The Lewinian model of experiential learning (cited in Kolb 1984) also offers a realistic combination of theory and practice. This model begins with the recognition of the need for change through observation and reflection. My invitation for the school to become involved in the project came after the schools had acknowledged their need for information and skill building in technology education. Introduction to the notion of technological practice and of unit planning processes and theory allowed the teachers to form abstract concepts of technology and technological practice (Kolb, 1984). These ideas were tested through a practical experience and developing ideas for learning experiences to be undertaken by the children. Concrete experience came with the implementation of the unit in the classroom and would continue beyond this study with independent planning and implementation of technology based on authentic technological practice (Figure 2.11).

Figure 2.11 ***The Lewinian Model of Experiential Learning and its Relationship to this Project (Kolb 1984)***

Concrete experience
Implementation in the classroom of the unit based on technological practice using assessment as an integral part of student technological practice

Observations and reflections
With my initial approach to schools there was evaluation and reflective process to determine that a staff member and the curriculum area needed professional development

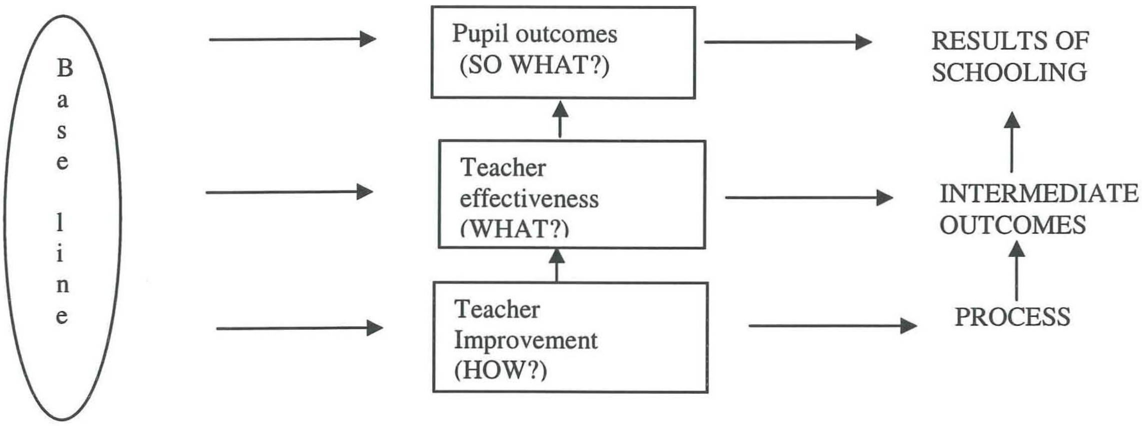
Formations of abstract concepts and generalisations
Introduction to the LITE knowledge domains and the concept of technological practice, identifying the relevant knowledge and writing a unit and assessment strategies plan to meet the identified need

Testing implications of concepts in new situations
During professional development the teacher applied the theory by identifying the relevant knowledge and incorporating it and technological practice with the identification of key assessment stages

Effectiveness of Professional Development

If professional development is to be deemed successful changes in behaviour for teachers and learning for children must occur. Stoll and Fink (1996) present a three dimensional approach for the evaluation of school effectiveness and school improvement. The three dimensions are school improvement (how), school effectiveness (what) and pupil outcomes (why) (Figure 2.12). The 'How' dimension discusses how the improvement process progresses and the 'What' dimension discusses what effects there are on teacher outcomes. For this project as I dealt with one teacher from each school I have modified Stoll and Fink's model by substituting 'teacher' for 'school'. In this case the third dimension - pupil outcomes (why) can be more accurately described as "so what?" as it describes the impacts of the professional development, that is what the teachers can do to enhance students' learning. In the sections below I discuss the 'How' and 'What' dimensions linked to this project. Mention of pupil outcomes occurs in the results and discussion sections of this project in Chapters Four and Five.

Figure 2.12 ***Evaluating Teacher Effectiveness and Teacher Improvement***



(Modified from Stoll and Fink, 1996; p.171)

The How Dimension: Approaches for Teacher Development and Management of Change

The 'How' dimension has a clear focus on process, in this case how teachers plan and teach technology education. The process of planning quality units of work is vital.

Enhanced teacher understanding in the four knowledge domains is crucial for teachers to give focused quality feedback to students in technology education. For this reason as a part of this study I decided to work with the teachers to enhance their understandings of technology by providing relevant professional development for them on the process of unit planning based on authentic technological practice using the identified knowledge domains to ensure children are being provided with relevant learning experiences.

The LITE research highlighted the need for teachers to develop relevant knowledge in the technological areas and practice in which they are teaching to maximise student learning. Relevant knowledge included that of authentic technological practice undertaken by experts in the field - knowledge, skills, techniques and processes. It also includes knowledge of development processes. However, unlike real technological practice, teachers need to intervene in student technological authentic practice at times to maximise the 'teachable moment' and improve the students' chances of developing successful technological outcome. It is this intervention that is missing if teachers do not have the required knowledge aspects and therefore affects the quality of student learning and their outcome.

To ensure teachers gained the necessary knowledge I also researched the relevant technological practice and existing technologies and then provided the teachers with a number of different resources for the unit. These resources included pictures of existing technologies, a video which allowed the children to witness an authentic context to the problem and a range of materials for an investigation the children completed. There are direct links to Hennessy (1993) here. Provision of these resources allowed the children to be embedded in authentic meaningful activity. The task required the children to design an aid for a one-handed person. The children were able to see that there was a genuine need for such aids and through the video that people with one arm actually do like to do things for themselves.

The What Dimension (Stoll & Fink, 1996): The Role and Place of Teacher Knowledge in enhancing Classroom Formative Interactions

This dimension considers what the teachers need to know for their successful implementation of technology- teacher outcomes when teaching technology. There is more to the development of knowledge in technology than just content knowledge included in the four domains of knowledge identified by LITE. Teachers also need to understand how students learn in technology. Moreland et al. (2001) have identified three interdependent areas of teacher competence, with respect to primary school technology education:

- the nature of technology- the development of understanding of what technology looks like in the 'real' world, an understanding of technological practice which is, what technologists do and how and why they behave the way they do during their practice.
- concepts in technology-the knowledge of ideas, principles, systems and jargon that are unique to technology and give technology its own academic standing
- technological pedagogical knowledge- understanding how and why students learn in technology. This informs the 'what to teach' dimension. It is important to establish the range of effective practices to use for implementation leading to an increased chance of developing outcomes that meet the needs identified.

Teacher knowledge and competence in these areas allow teachers to facilitate learning for students to gain understanding in their own and others' technological practice. Teacher knowledge of the subject (content knowledge), how students learn (pedagogical content knowledge), and interaction of these two factors are essential to support learning (Moreland et al., 2001). Sound content knowledge has a positive effect on planning, assessment, implementation of curriculum and curriculum development. This in turn enhances student learning as teachers are able to maximise student learning by asking questions, facilitating discussion and challenging students to find solutions for themselves or intervening in student technological practice to aid development and understanding without students losing ownership of their learning. The LITE research project found that a relevant knowledge base for teachers was pivotal for effective technology teaching and for expecting teachers to add technology to the learning areas that they are required to teach. Shulman, (1987, cited in Moreland et al., 2001) strongly emphasised the need for teachers to build this base for teaching.

Professional development programmes need to be planned to allow teachers to gain the required content and understanding. Shulman suggested that teaching began with an understanding of what was to be learnt and what was to be taught. This might include modelling of strategies. His framework included knowledge of content, general pedagogy, curriculum, pedagogy content, learners, educational contexts and educational ends. Teachers were challenged while searching to construct a coherent technological content base and appropriate assessment practices (Moreland, Jones, & Chambers, 2000). Sadler (1988, cited in Moreland et al., 2000) outlined six resources that competent teachers bring to assessment:

- knowledge about content or substance
- positive attitudes towards learners and learning
- skill in devising tasks
- knowledge of criteria and appropriate standards
- skill and expertise in previous similar tasks
- expertise in giving appropriate targeted feedback.

Teacher knowledge of the discipline is related to the use of various assessment processes, since it is critical that teachers have knowledge of the discipline to provide direction for learning. When they are unsure of the discipline's structure teachers are not well equipped to guide or assess that learning. Development of conceptual and procedural knowledge in technology enables teachers to write specific learning outcomes, and to display more confidence between the dimensions of the nature of technology and specific technological learning outcomes allowing differences in children's learning to be better identified. This means teachers can become more focused on the technological learning of their students. Knowing technology as a subject makes it far easier to have high quality formative interactions with the students (Moreland et al., 2001). Teachers value the following intervention strategies:

- identifying specific and overall learning outcomes rather than just activities
- identifying procedural, conceptual, societal and technical learning outcomes

- summative assessment during the unit as well as at the end
- questioning and using technological vocabulary
- an iterative (repeated) use of models
- allowing for multiple outcomes.

Teachers on the LITE research project moved from thinking about progression in terms of a series of activities to examining the conceptual and procedural aspects of student learning. The focus on more precise formative interactions has enhanced students' learning (Moreland et al., 2001).

In summary awareness of how to plan and implement technology programmes that reflect authentic practice and what enhances or inhibits students' learning are fundamental to quality professional development in technology education. Stoll and Fink (1996) offer a framework to evaluate the effectiveness of professional development. As indicated above there is clear evidence that the programme I offered to teachers was balanced between the 'how' and 'what' dimensions. The success will be reflected in the 'why' dimension which is a shift in student learning resulting from the professional development undertaken by teachers.

Aim

The aim of this study is to compare Year Four children's achievement in technology education by comparing achievement levels in a task given out-of-context to that of the same task embedded in a unit of work based on authentic technological practice (in-context). If there are differences in achievement levels they may be attributed to the difference in teacher knowledge and understanding and the unit planning process and/or the learning the students undertook during the unit. I believe this may indicate that the 'out-of-context' assessment tasks as administered by NEMP are not the most valid way of assessing performance and achievement in technology education.

Research Questions

Key Question

What is the relationship between the context of an assessment task and Year 4 children's ability to demonstrate what they know and can do in technology education?

Questions

1. Compare and contrast the results of the same NEMP task administered using the same guidelines in two different contexts: one as an 'out-of-context' previously unsighted task and one as a part of authentic technological practice (in-context).
2. How does technological practice allow children to demonstrate their ability to design solutions to meet identified needs in technology education?
3. How does a technology education unit based on authentic practice including conceptual, procedural and societal knowledge improve child performance?

Chapter Three: Method

Introduction

This investigation has included working with one NEMP task in two different ways. The first use involved a replication of the task as administered by NEMP, which I have called the 'out-of-context' task. The second way was to use the same task but embedded within a unit of classroom work based on authentic technological practice. I have called this the 'in-context' task. The purpose of this project was to compare achievement levels of Year Four children in the 'out-of-context' task to that of the 'in-context' task. I wanted to know whether student achievement in technology education could more accurately be determined within authentic technological practice.

The sections of this chapter provide details about the NEMP task, the sample of schools and teachers and how the task was used with the teachers and in the classroom setting. The chapter concludes with a discussion of the challenges the researcher encountered in the data gathering process and how these were addressed.

Types of Tasks

There are a number of different approaches used by NEMP in the implementation of assessment tasks and a number of different types of tasks. These include one-to-one, group, station and independent tasks. **One-to-one** tasks are taken on a one-to-one ratio with the administrator. **Group** tasks require students to co-operate to complete the given task. **Station** tasks require the students to work independently and finally some tasks are **independent** tasks where the students work in-groups of four working on the same task independently (Crooks & Flockton, 2001).

Some tasks are identified as **Link** tasks and are repeated four years later to allow comparison between assessments (i.e. 1996 and 2000) and not able to be used for other purposes so that students cannot be coached or taught the task specifically.

The Task

I initially decided to select a task that was in either the independent or station category identified by NEMP. This was because the children worked individually in these two categories. This would make results of the task easier to analyse and allow the teachers to use the data gathered for assessment and record keeping purposes in the classroom because it provided valuable information on individual performance. I also determined that the task needed to come from the B Strand 'Technological Capability' in *Technology in the New Zealand Curriculum.* This was because Strand B tasks require the planning or development of tangible outcomes and are more likely to be influenced by the learning that precedes it in the other two strands. In technology education units of work contain learning experiences from all three strands. Thus learning from Strand A (Knowledge and Understanding) and Strand C (Technology and Society) should inform student technological practice which occurs in Strand B.

I selected the station task 'Help Me Peel' from NEMP 2000 *Aspects of Technology* (Figures 3.1 and 3.2 and Appendices 10-13). The task required children to plan an aid to help a one-handed person peel a potato. The children were given a photograph of a child with a broken arm trying to peel a potato. The instruction sheet asked them to plan something to help the girl peel. During the actual unit all children in all of the classes were given a brief to work from, this identified the need to peel the potato one-handed and gave some guidelines (Appendix 12). At the teacher professional development day the teachers decided on the wording in the brief. They decided to name the girl in the picture Amy for ease of referral. For completion of the actual task the children were given the task cards as well. A copy of the task and instruction card follow.

The 'Out-of-context' Task

In the 'out-of-context' task, as with the original NEMP task the children were required to plan their aid without any knowledge or learning within the context or field of practice.

The instructions for the task were modified as a consequence of the marking undertaken by NEMP. During 2000 when this task was administered to children as a part of the NEMP programme of assessment a significant number of children suggested that they would get another person to help as a solution to the problem. The original intention of NEMP was that the solution should not require this (Liz

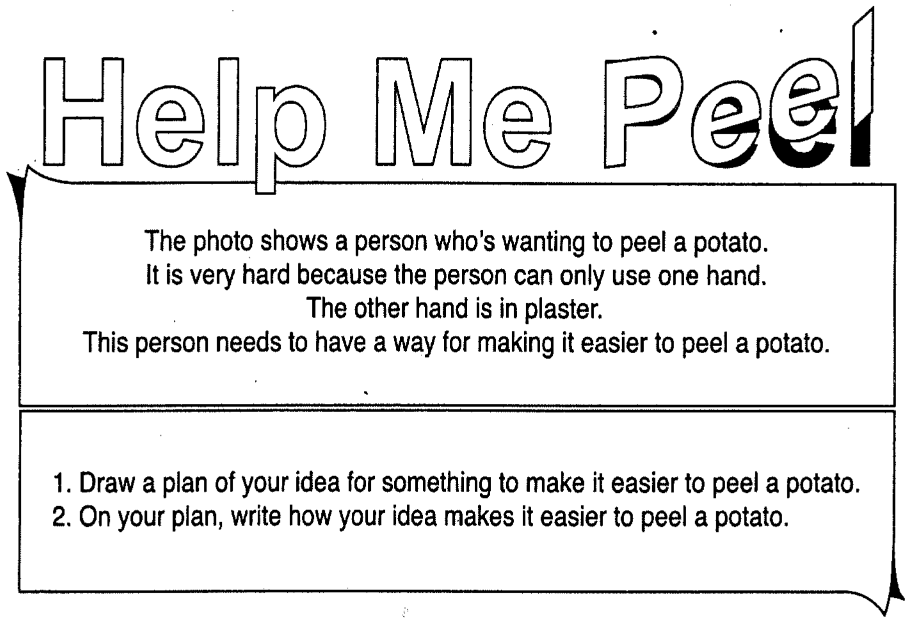
Eley, personal conversation, 25 January 2002). Therefore I added the instruction that the peeling task needed to be done with no other human help as a solution to the problem. I had comparatively small numbers in my sample group and needed to avoid this option being explored by them. The instructions were read to the children to help those who might have had difficulty reading the instruction card. I then added that no other person could help the girl in the photo.

The 'In-context' Task

The same task was used as the 'in-context' task, which occurred as an integral part of the collaboratively planned unit, which was planned and written during the professional development day provided for selected teachers. The professional development and up-skilling of teachers in unit planning and teaching in technology education was based on the development of teacher content and pedagogical knowledge.

Figure 3.1: ***Help Me Peel Task Photo provided for this study by NEMP***

Figure 3.2: ***Help Me Peel Instruction Card provided by NEMP for this study***



Help Me Peel

The photo shows a person who's wanting to peel a potato.
It is very hard because the person can only use one hand.
The other hand is in plaster.
This person needs to have a way for making it easier to peel a potato.

1. Draw a plan of your idea for something to make it easier to peel a potato.
2. On your plan, write how your idea makes it easier to peel a potato.

The Sample

A letter was sent to all primary school principals in Christchurch and Kaiapoi early in 2002, asking for teachers of Year Four children, to voluntarily enter the project (Appendix 3). I restricted the population to keep travel costs to a minimum. Response to the initial letter was very good with over thirty replies received.

Selection of Sample

For my sample I required two schools from each SES category because the NEMP results indicated that the school's SES (Socio-Economic) index influenced results (Crooks and Flockton, 2001). To achieve this I selected the first two schools to reply in each SES index band.

Justification of SES Consideration

The SES index is based on census data for the census mesh blocks where children attending the school live. The Ministry of Education in New Zealand categorise schools and base funding and support on this SES index. The SES index took into account household income levels, categories of employment and the ethnic mix in the census mesh block. The SES index includes 10 subdivisions each containing 10% of schools (deciles 1-10). For NEMP purposes, the bottom three deciles (1-3) form the low SES group, the middle four (4-7) form the middle SES group and the top three (8-10) form the top SES group (Crooks & Flockton, 2001, p. 49). Other influencing factors were noted in the design of my study. For example I considered ethnicity but decided not to consider it separately because this factor is taken into consideration when SES levels are established. I also considered school geographical location and/ or size but decided not to consider these also because they had no influence on NEMP 2000 results (Crooks & Flockton, 2001).

The NEMP findings served to justify my use of stratified sampling and enabled me to divide the population into strata based on supplementary information (Neuman, 2000). I therefore worked with six classes (two in each SES band) and only one Year Four class from each school.

Selection of Teachers

Each reply identified a teacher of Year 4 children within the school. The selection of the teacher within each school was the responsibility of the principal. In all but one case teachers were asked if they were interested and voluntarily entered the project. One teacher (School A) was required by her principal to participate, but did so willingly. Once teachers were selected I contacted them and the principals thanking them for agreeing to be a part of the project (Appendix 4 a & b). I also outlined the project and intended timeline. In both my initial contacts with the school and the classroom teacher, anonymity was assured.

Participating Schools

Given below are details of the participating schools including information in school type and size, parent expectations, decile rating, class size, special needs, behaviour and cultural mix of the class. Where the class was a composite class (more than one year level) I used only Year Four children. This information serves to provide some background regarding class size, the schools' approach to technology and the type and ethnicity of children in each class.

School A

School A was an independent, girls' school affiliated to the Anglican Church. It had pupils from Years 0 to 8 inclusive and was in the top decile band. It had a purpose built technology facility which teachers were encouraged to use. Parental involvement and expectation in the school and children were very high. Parents were mostly professional. The school had small class numbers; they generally had around 20 children in each class. The class in this project had a roll of 20, was a straight Year 4 class and predominately Pakeha with one student from an Asian background. She had English as a second language. Teacher A considered the children in her class very well behaved with no behaviour problems.

School B

The other school in the top decile band was School B. This school was also an independent school. The school drew on children from all over the city. Like School A it was affiliated to the Anglican Church and was an all boys' school with pupils from Years 0 to 8 inclusive. The parents were mostly professional and had high expectations of the school in terms of academic, cultural and sporting achievement within the school. There was little practical technology taken throughout the school. Classes generally had around 20 children. The Year 4 class in this project had 24 children. This class was also predominately Pakeha, there was one Korean whose English was "pretty good". Teacher B made the following comment about class behaviour. "Generally pretty good. I have got one ADHD boy and a couple of dreamers actually who aren't with you but on the whole yes (well-behaved)" (Teacher B, Interview One, April 23 2002).

School C

School C was a middle sized state school in the middle decile band (4-7). It had pupils from Years 0 to 6 inclusive. It had five other primary schools surrounding it so attracting pupils was a major focus for the school. The parents were very supportive and "want the best for their children at all times" (Teacher C, Interview One, April 18 2002). The school community appears to be a close knit team with the 'Home and School' group quite involved in the school.

There were significant numbers of foreign fee paying students in the school, mainly from Korea. The class in this project had 29 students and was a Year 3-5 class. There were slightly more boys than girls. Teacher C believed her class was typical of others in the school. Four in the class were Korean, with English as a second language- two recently arrived with very little English. The class also had two Maori children, one Cook Islander, and one part Maori. This class also had one profoundly deaf boy who had teacher-aid support each morning and most of the afternoons I was in the classroom. He is on an Independent Education Plan (IEP) to ensure that a programme to meet his needs was in place. The teacher wore a microphone when talking to the whole class so that he was able to hear teacher conversation. Another boy had a hearing deficiency, also wearing a hearing aid.

Teacher C made the following statement about the behaviour of her class.

> The majority of the class is well behaved. They are very social and chatty. ....A couple of the boys have some behaviour needs especially social needs. I have got a wee group of 4-5 boys who cannot work in a group....Generally really good kids. Enthusiastic. (Teacher C, Interview One, April 18 2002).

School D

School D was a small catholic integrated school with pupils from Years 0 to 8 inclusive. The school community was parish based, which meant they worked in with the parish and did many activities together. School D was also in the middle decile band. The Year 3-4 class in this project had 24 children. Approximately half the class were a culture other than Pakeha. Teacher D believed this was typical of the rest of the school. There were no Maori children, but there were Vietnamese, Korean, Chinese, Philippine, and Tongan children in the class. Three members of the class had English as a second language. Teacher D believed the general behaviour of the class was good.

School E

In the lower decile band (1-3) School E was a small to middle sized state school, with pupils from Years 0 to 6 inclusive. The pupils at this school and in this class had a diverse ethnic background. The school had a transient population. There were also a number of foreign fee paying students in the school, mainly from Korea. Three children in the class had English as a second language. This Year 3-4 class had 32 children with 21 girls and 11 boys. Teacher E had a teacher aid for four mornings a week for three children with severe behavioural problems. Teacher E believed having more girls balanced out some of the naughtiness of the class.

School F

School F was a large state low decile school in an industrial part of the city, with children from Years 0 to 6 inclusive. The school drew on a large community and had a declining roll. The parent body was generally fairly supportive. The Year 3-4 class in this project had 26 children. The children in this class were mainly Pakeha, but with two American Samoans with English as a second language and three children who identify Maori. This mix was typical throughout the school. Teacher F believes her class was needy in terms of reading, however their behaviour was reasonably good but their attention span was short.

Group One and Group Two Schools

For the study I split the schools into two groups. Each group had one school in each decile band. To do this I put the schools in each band in alphabetical order by school name and selected the second school in each to participate in the 'out-of-context' task (pretest) before the unit of work was taught. These schools were Group One (Schools A, C and E). The other three schools, Group Two schools, were not exposed to the task as an 'out-of context' task. These schools were Schools B, D and F and were assessed during the unit only ('in-unit' task). It was necessary to have to two groups of schools so that I could determine if exposure to the 'out-of-context' task influenced results of the 'in-context' task. By having a set of schools who was not exposed to the initial task I was able to determine if the classes exposed to the task out-of-context were sensitized by the two exposures.

Table 3.3: ***The relationship of schools in the research group to control and to decile bands.***

Class	NEMP Task 'out-of-context''	Authentic Task 'in-context'
1 (SES 8-10) **School A Group 1**	✓	✓
2 (SES 8-10) **School B Group 2**		✓
3 (SES 4-7) **School C Group 1**	✓	✓
4 (SES 4-7) **School D Group 2**		✓
5 (SES 1-3) **School E Group 1**	✓	✓
6 (SES 1-3) **School F Group 2**		✓

Selection of Children

There were 17 children in the 'out-of-context' task group. Initially I intended there to be 18 children, six from each school (Group One schools) but when I went to School C to take the 'out-of-context' task one of the six children who had returned the permission slip was absent. These children were selected alphabetically by *first* name and I selected the first six on the roll. The results from the 'out-of-context' task enabled baseline achievement levels to be established. I am confident that the non-biased procedures I used produced a cross section of ability and ethnicity. The teachers confirmed this when I gave them a copy of the list of children. There was no prior warning or learning for this task.

There were 36 children in the 'in-context' group, six from each school. These children were selected in the same way as the 'out-of-context' sample except that the surname was used to ensure a different group of children were selected on criteria that were unlikely to influence the results of the task. Six children across all Group One schools happened to be selected in both groups.

Data Gathering

'Out-of-context' Task

I arranged with each teacher to enter his or her class at a mutually convenient time. gathered the identified children from the classroom and took them to a predetermined space: the library, withdrawal space or spare classrooms were used. The children took a pencil and a rubber with them. I gave them the task photo and instruction card and the planning sheet provided by NEMP (Appendix 13). I then read the instructions, modifying them as discussed. The children sat where they were unable to see other children and were given as long as they needed to complete the task. When they had finished I gathered their plans and they returned to their classroom. The children took approximately 15-25 minutes.

'In-context' Task

The 'in-context' task was completed when the children were partially through the Help Me Peel unit, after their investigations and initial sketches. I taught the unit alongside the classroom teachers. I facilitated most of the lessons; the teachers decided this. When the children were ready to begin planning I withdrew them and administered the task in exactly the same manner as before. On completion, I took the plans and copied them for the children so that they were able refer to them while making their aids. The children took between 20-30 minutes to complete this task.

Interviews

I interviewed all six teachers after the professional development day. I interviewed each teacher twice; both before the unit started and after the unit had been completed in the classroom. I used a semi-structured approach to the interviews. The semi-structured interviews allowed the teachers more freedom than a more structured approach. The questions were open ended and allowed me to explore the questions further when the need arose. Semi-structured interviews enabled the interviewee to give their own perspective more freely and for the interview to be more like a conversation (R. Burns, 1998; Cohen, Manion, & Morrison, 2001). The semi-structured nature of the questions still meant that comparable data could be gathered across subjects (R. C. Bogdan & Biklen, 1992).

A more structured approach to the interviews would not have allowed the teachers to use their experiences and perspectives to the same degree and would have limited their responses which may have distorted the meaning (Cohen et al., 2001).

The *purpose of the first interview* was to gather teachers' opinions about their professional development experiences, for me to identify their feelings about the project and to discuss their intended practice or their interpretation of the unit. The *purpose of the second interview* was to discuss how their understanding of technology had changed during the project and to discuss their actual practice-whether they actually followed the unit.

One disadvantage of the semi-structured approach was that in the first interview the teachers didn't know me very well and were still unsure of themselves regarding technology education. Responses tended to be short and more restrained than in Interview Two. In hindsight it might have been better to have used a more structured approach here. During Interview Two, which occurred just after the unit, teachers talked much more freely.

Justification of the Interviews

The same unit of work was taught in all six classes. This treatment allowed me to determine the impact improved teacher knowledge and planning based on authentic technological practice had on achievement levels of children in the selected task. It was important that the same programme was delivered to the children to ensure that some schools were not advantaged by extra activities and learning. By asking the teachers to discuss their intended and actual practice this allowed me proof that the treatment was the same in all the classes.

The Process of Data Analysis

The next stage involved quantitative analysis of the children's assessment tasks, details are reported in Chapters Four and Five. This was to determine if there was a difference between the results gathered in the 'out-of-context' task and those undertaken as a part of the unit ('in-context' task). Tasks were analysed using the aspects and categories determined by NEMP and the sub categories determined by me to ensure consistency across all the data (Figures 3.4 -3.7). The 'out-of-context' task was analysed after the unit was taught. This ensured that the information gained didn't influence the approach to unit planning and teaching. The process I used for the data analysis is detailed at the beginning of Chapter Four.

I considered detailed analysis might serve to indicate the effectiveness of teachers' teaching and how their improved knowledge and practice improved student achievement. If little or no difference were determined this would show that the unit taught had made little impact on children's learning and on assessment results.

Marking Criteria

To ensure that the tasks were assessed in a similar manner to that of NEMP I requested and adopted the marking aspects and categories for this task used by NEMP in 2000. (Appendix 19) NEMP had assessed five aspects:

1 A Second person is required
2 Quality of the Solution
3 Quality of plan/ diagram/ picture independent of its workability
4 Quality of Explanation
5 Nature of the Solution

I used aspects 2-5. Aspect 1 was not used because of the alteration to the instructions, which made it inapplicable. Within each aspect identified by NEMP three or four assessment categories were also determined. Both the aspects and the categories provided by NEMP appear in *Italics* in the Tables 3.4-3.7.

Justification of Decision Making for Marking Tasks

When NEMP assessors mark the selected task there are a large number of markers who discuss, compare and moderate their findings to ensure consistency of standards. To ensure consistency in this project with only one marker I decided I needed further categories or sub-categories within each of the categories determined by NEMP. These can also be seen in tables 3.4-3.7 as bullet points below each the NEMP categories. The point values allocated to each category by NEMP are also in tables 3.4-3.7. For each aspect, categories were given a numerical score, which indicated the value of a response. For example, were a plan quite detailed the child scored 2. This allowed a numerical score to be calculated for each child.

Another change I made was in the fifth aspect, 'Nature of the Solution'. I added another category that I believed to be of equal rating to that of holding the potato still, and that was 'allows for the aid to be held still or stabilised'. I came to this decision through research into existing aids currently on the market for one-handed people and discussion with Vaughan Hill (the video interviewee). Vaughan talked about the importance of the aid not slipping and sliding across the table or bench when it was used. I believe that the children needed to get credit if they recognised this aspect and had included it in their design. I gave it an equal weighting as 'hold the potato still" because holding the potato still may not be effective if the aid slips away from the peeler.

Tables 3.4 - 3.7 The aspects and categories determined by NEMP and the points allocated to each are in the top row. In the second row are the sub categories that I identified as key components for each of the given categories.

Aspects, Categories, Sub-Categories and Numerical Values for 'Help Me Peel' Task

Table 3.4 *Aspect 1 - Quality of the Idea/ Solution- Its workability*

Quality of the idea/solution Its workability	*Clearly Workable* 3	*Probably workable* 2	*Possibly Workable* 1	*No Solution/ unworkable solution* 0
	• Able to keep potato still- e.g. cup, two nails/sticks • Able to be held secure on the bench-plastic matting or suction cups • Appropriate size and materials • Can be used by a one-handed person	• May keep potato still-, one nail/stick • Aid may be held secure on the bench • Size and materials not clearly stated • May be able to be used by a one-handed person	• Keeping the potato still considered but probably won't do it • No way to secure aid to bench • Size not considered • Materials not considered • Probably won't work	• Won't keep the potato still • Can't be secured t bench • May be futuristic and little likelihood of being able to be produced now or in the future • No solution offere

Table 3.5 *Aspect 2 - Quality of the Plan-Independent of its Workability*

Quality of Plan/ diagram/ picture Independent of its workability	*Quite detailed* 2	*Rudimentary* 1	*No plan/ diagram/ picture. Scored if there is no plan/ picture/ diagram offered* 0
	• May offer two views • Measurements given • Most materials mentioned	• Plan draw with no annotation • No measurements • Picture very basic	• No solution offered

Table 3.6 ***Aspect 3 - Quality of the Explanation-Independent of its Workability***

Quality of Explanation	*Quite detailed* *2*	*Rudimentary* *1*	*No Explanation Scored if there is no explanation* *0*
	• Discusses how it will make it easier to peel the potato • Explanation expands on information given in the diagram/picture	• Discusses the picture but gives little or no relevant information on their design	• No explanation offered

Table 3.7 ***Aspect 4 - Nature of the Solution***

Nature of solution	*Ways of holding potato still (so can be operated with a single hand)* *5*	*Ways of holding aid still (so can be operated with a single hand)* *5*	*Ways of holding peeler still (so can be operated with a single hand)* *4*	*Machine* *3*	*Getting somebody else to help by holding (so you can peel potato with a single hand)* *2*	*No Workable Solution/ any other response* *0*
	Will offer at least one of the following: nails at least two, split pins or skewers, cup formation, holes or wedge for the potato	Will have at least one of the following: matting on the bottom, suction pads on the bottom, clamp to attach to bench or table, method of trapping the device	A device that holds the peeler still so the potato can moved against the blade. Must mention the moving of the potato against the blade	Will use electricity May have a motor Possibly be futuristic	Will involve another hand or other hands in the operation	Solution unable to be made and or unrealistic for the intended purpose

Total scores were calculated for each child in each task. This allowed me to identify low and high scoring plans for both tasks. Six children were selected for both the 'out-of-context' and the 'in-unit' task within each school. These children received a score for both. The scores for each school were totaled and averaged.

Analysis of the Interviews

The semi-structured interviews were audio taped, transcribed and then colour coded under the following categories; actual practice (pink), links between the activities undertaken by the children and the success of the unit (green), value of the professional development- the whole experiences (blue), schools' impacts on achievement (yellow).

Researcher's Role

I was in the classroom as much as possible for the teaching of the unit in all of the schools. When I was unable to be in the classroom I was in close contact with the teachers throughout the unit. For approximately 80-90 % of the planned lessons I was in the classroom. Nearly all the resources, equipment and materials to support the teachers were provided by me. These included organising a video, gathering the range of materials and providing the peelers, carrots and potatoes for the children to experience peeling. It also included supplying cardboard, plastic, custom wood, hot glue guns and glue, spray paint and other necessary small items. In all but one case the units were taught over a three-four week period, School A in the first half of Term Two and the other schools in the second half of Term Two 2002. Throughout the unit there continued to be on going evaluation through informal discussion between the teachers and myself. This ensured a consistency in approaches of delivery between the six classrooms.

Project Stages

The research project involved three stages:

- Professional Development for the Teachers
- Classroom Implementation of the Unit
- Analysis of Results (presented in detail in Chapter Four)

Stage One: Teacher Professional Development

My aim for the project was to offer schools and teachers a 'win-win' situation. My offer included a fully funded day of professional development in technology education for six teachers of Year Four children. The day consisted of seven hours together in a central location with me as the facilitator.

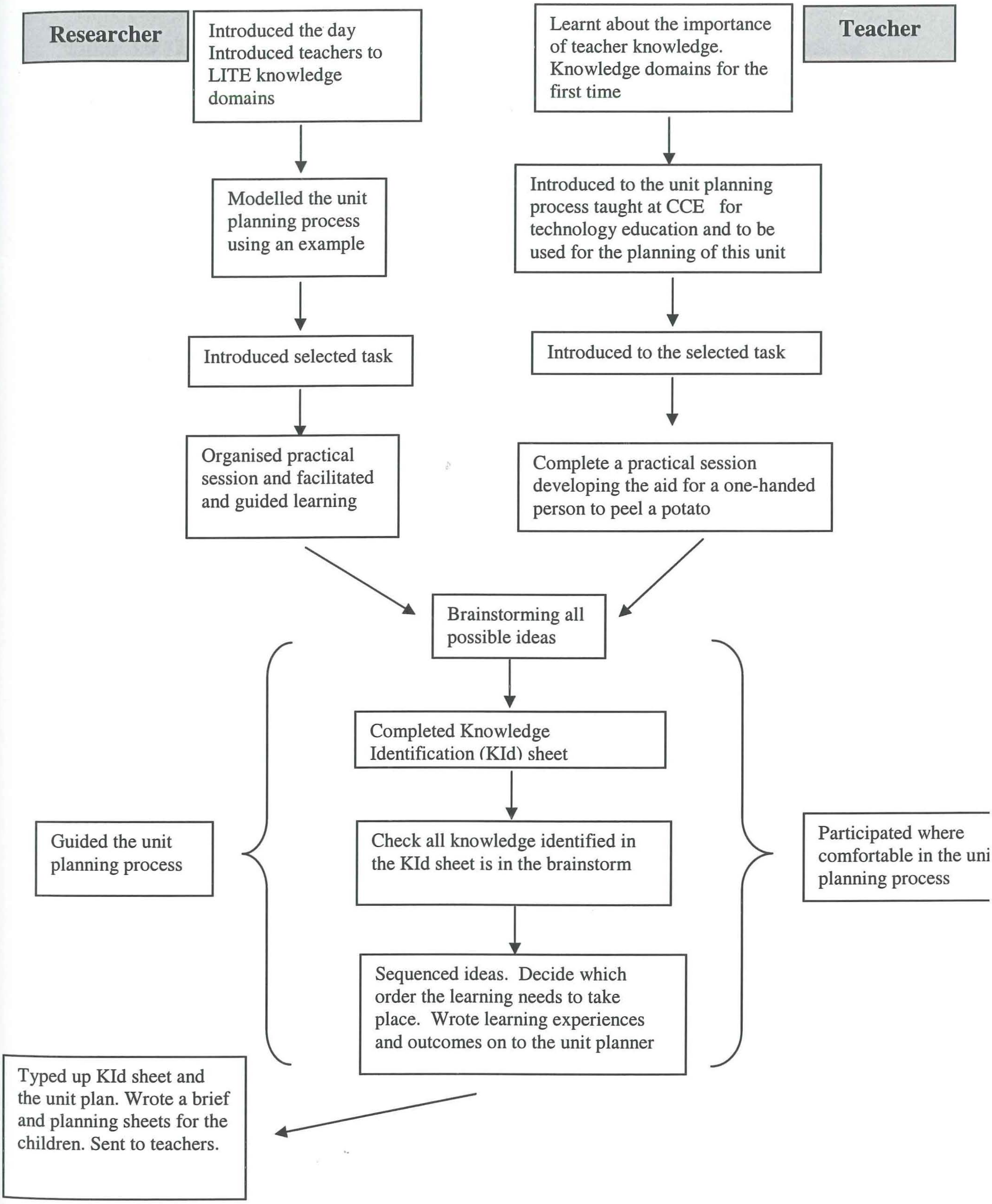
McGee's (1997) elements for successful professional development were evident. The teachers in my study were very willing and flexible throughout the process. They welcomed the opportunity to share their ideas and concerns and embarked on a journey of discovery into teaching a unit of work in technology education.

The Professional Development Experience

My role as the researcher during the professional development day was to ensure that the teachers were able to improve their understanding within these dimensions (see Figure 3.8).

I adopted Fullan's (1991) framework of initiation, implementation and continuation when working with the teachers. The Initiation Phase began with initial contact and overview of this study. The Implementation phase featured the professional development day outlined above. The Continuation phase extended the previous two phases with the classroom implementation of the unit. The children's progress was closely monitored throughout the teaching and minor adjustments were made as necessary.

Figure 3.8: ***Comparison of the researcher role and teacher role during the professional development day.***



Joyce and Showers (1995) identify five components of well designed training programmes. These components are identified in Table 3.9 below.

Table 3.9 ***The relationship between the five components of quality teacher training content and the content I delivered to the teachers in the project.***

Component	Activity
Theory about the topic	LITE theory showing knowledge domains.
Live and mediated ***demonstration*** or modeling of new skills	Model of the unit planning process and explained the process.
Opportunities for ***practice*** in training and in the classroom	Cooperative planning of the unit which included practical participation in the task and team teaching a technology unit in the classroom
Feedback	Comment on observations of children's learning and classroom teaching processes.
Further coaching	Further offers of planning support made.

The components of this model match to the activities I offered teachers during their professional development day. A key word for each component is written in Italics. This shows that the professional development I offered to teachers has direct links to Joyce and Showers' model.

Teacher Knowledge and Confidence in Technology Education

In my role as an educator in technology education I have noted that many teachers lack knowledge and background in teaching technology and that they still connect it to either 'high tech' programmes including computers etc. or they think it is linked to 'manual training'. Many teachers in New Zealand have not been trained in technology education in their teacher education programmes and few have experienced professional development in this area. This is why teachers are unlikely to have a good knowledge base to teach technology effectively.

In their research Moreland et al. (2000) contend that effective teaching in technology is positively influenced by the development of a knowledge base for teachers. Shulman (1987, cited in Jones & Moreland, 2001) shares a similar view but that this knowledge should specifically include content, general pedagogy, curriculum, pedagogy content, learners' educational context and educational ends. Jones and Moreland (2001) suggest dimensions of knowledge are needed for effective technology teaching. These are knowledge about technology, knowledge in technology and general technological knowledge. Such emphasis on the adequacy of teachers' knowledge bases can be linked to the theory step in Joyce and Showers' 5 Step Model

Stage Two involved giving selected children from one school in each decile band the 'out-of-context' NEMP task using NEMP guidelines

Stage Three: Classroom Implementation of the Unit

In terms of the professional development offered to teachers the classroom application phase demonstrated step two (demonstration), step three (practice) and steps four and five (feedback and further feedback) in Joyce and Showers' model of quality teacher training. I worked in front of and with the teachers with regular opportunity for feedback.

Authentic technological practice can be defined as the practices used by practitioners to meet an identified need. A requirement for successful implementation of the unit was the sequencing of learning activities for the children so that they mirrored the types of activities a developer of such aids might adopt as part of their normal technological practice. For the purpose of my research I argue that authenticity is more apparent in the 'in-context' task than in the 'out-of-context' task. The points listed below link the children's learning experiences with the definitions of authentic assessment tasks as previously discussed in Table 2.6.

- *performance justification* - the plan the children produced was discussed with their teachers and/or peers, they then went on to make their aid so the quality of the plan was important to the practice and therefore relevant. This is a part of modelling authentic practice as technologist regularly present their ideas to team members, bosses and/or clients etc.
- *know as much as possible in advance* - the children were presented with the brief well before they were given the task and were aware of what they had to do before they were given the task. This was

not the case with the 'out-of-context' task. Again reflects technological practice. Technologists start with a brief around which they base their research.

- *a model of real world practice and knowledge and judgment innovatively used* - during the 'in-context' task children were required to use the knowledge they had gained through their research, as technologists do.
- *students able to self adjust after feedback* - the task had no "right answer" and many children went back to their plans and changed them after they had made their mock-up designs (the changed plans were not recorded in this study). Constant evaluation and modification of designs are a normal part of technological practice.
- *validated against core based adult roles* - the task the children were required to do was preceded by a number activities that could also be a part of authentic adult technological practice in the same field. Technologists who develop aids for people with disabilities are likely to investigate those aids already on the market, talk to people with disabilities to determined their requirements and investigate suitable materials. Criteria are then established with draw plans. A mock-up is commonly constructed and evaluated before the final product is developed.

Learning Experiences Undertaken by the Children

The next section provides a description of the learning processes for the children who experienced the unit. Such detail is included to highlight the instructions given to the children, the learning sequence and why the teachers considered the various steps to be important in the children's learning.

All children were introduced to the concept of developing the aid. The children then experienced peeling carrots and potatoes to ensure they were familiar with the task required of Amy. Carrots were chosen first as the teachers thought they were a little easier to peel than potatoes. The children were shown how to hold both the peeler and the vegetables, and what action was required. This activity allowed the children to develop an awareness of the action of the peeler and the role of the other hand in the peeling process.

The children also viewed the video of Vaughan Hill, an amputee who lost his arm above the elbow in a shark attack. I interviewed Vaughan at the College of Education near the end of the first term. I decided to use video for the interview, as I felt uncomfortable about asking Vaughan to speak at six different schools and the video also became a resource the teachers could use again. In the video Vaughan discussed his disability, the accident and the impact it had on his life, how he felt the need to be independent and do things for himself. He also talked about and shared with us some of the things he used to help him accomplish everyday tasks such as doing up shoelaces, putting on shoes, cutting vegetables and steak and buttering toast. This video interview served a very useful purpose because it added a very authentic social dimension to the unit. Children were made aware of the actual need to develop such aids and that such development has improved quality of life for disabled people. They also saw that such aids existed what they looked like and what they could do.

The children experienced some playground time with an arm under their jersey so they only had one hand. Some schools did this over lunchtime so that the children could attempt to eat their lunch and play after lunch, others over playtime so that the children experienced eating a snack and playing. One school took the children to a playground during class time. These children experienced playing on the jungle gym one-handed. Afterwards all children discussed their feelings, frustrations and challenges of not being able to use both arms.

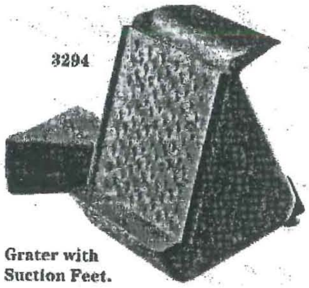
For homework and through class discussion, the children asked questions and offered their ideas about who are the people who have one hand and why they might have the use of only one arm. Such things as arthritis, amputees, broken or dislocated limbs, birth conditions, and disease were discussed. Later the children questioned parents, grandparents and other family members and returned to school for a whole class discussion.

My intervention also included introducing a further set of resources, from *Enable New Zealand*. *Enable New Zealand* is an organisation in New Zealand that provides information and support for people with disabilities. These pictures provided useful information about the key features and characteristics of aids for one-handed people. Using a range of small photographs of a variety of aids for one-handed people the children investigated and wrote a statement identifying a feature of each that made it suitable for one-handed people. Figure 3.10 is a sample page from the catalogue provided by *Enable New Zealand*, it shows a grater with suction feet to hold it stable when the one-handed person uses it. Also included in the catalogue are instructions on how to purchase it. For this investigation I copied just the photos. I copied three to four of each aid so that all children in a group had the same picture to look at.

Figure 3.10: *Sample Page from Enable New Zealand Catalogue*

Make:
Model: Grater with Suction Feet
ManuID: 3294
Catalogue: Sammons Preston

ISO Classification:
15 Aids for housekeeping
03 Aids for preparing food and drink
06 Aids for cutting, chopping, and dividing



Description

Suction feet hold grater in place for the one-handed user.

Specifications

Features/Options

Comes with reversible plastic plate for fine or course grating.

Service

Notes

Supplier

Medix 21 Ltd
7 Mana Esplanade
Paramata
P O Box 54 117
Mana
Wellington, 6230
Tel : (04) 233 1627
Fax : (04) 233 1933
Call Free : (0800) 633 492
WWW : www.medix21.co.nz
Email : medix21@xtra.co.nz

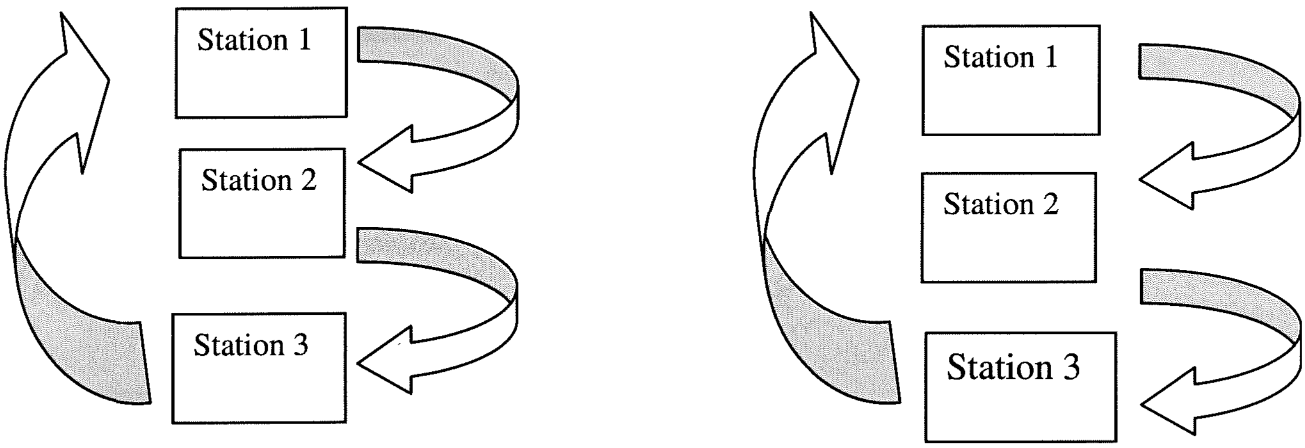
Printed on 24/05/2002 from Equipment/Suppliers database maintained by Enable Information - a service of Enable New Zealand
CallFree 0800 17 1981

The children also took part in an investigation into suitable materials for aids. They had to make decisions about washing and scrubbing, durability and stability. This was done in a rotation of three stations. The materials investigated were:

- coreflute (plastic corrugated cardboard like product)
- cardboard
- Customwood
- painted Customwood
- polystyrene
- styrene plastic (similar to margarine container plastic)
- Vivac Plastic (similar to ice cream container plastic)
- bubble plastic
- plastic matting.

Each class was divided into six even groups, two for each of three stations. This was done to decrease the number of children in each group to between four and five. The children rotated in groups around one set of stations shown in figure 3.11. The arrows indicate the flow of the groups of children.

Figure 3. 11: ***The station organisation for the materials investigation.***



I provided the above materials cut into pieces for each station for each class. All classes investigated the same range and size of materials. I also provided the instructions for the teachers and set up and facilitated the investigation. At each station the children were asked a series of closed questions. I deliberately chose closed questions with yes/no answers so that the focus of the investigation was the materials and not recording detailed information. Details of each station are given below.

Station One Washing and Scrubbing

At Station One the children were given instructions to take a sample material and put it in water. Then they answered questions such as:

Did the water damage the material?

Could the material be scrubbed in soapy water?

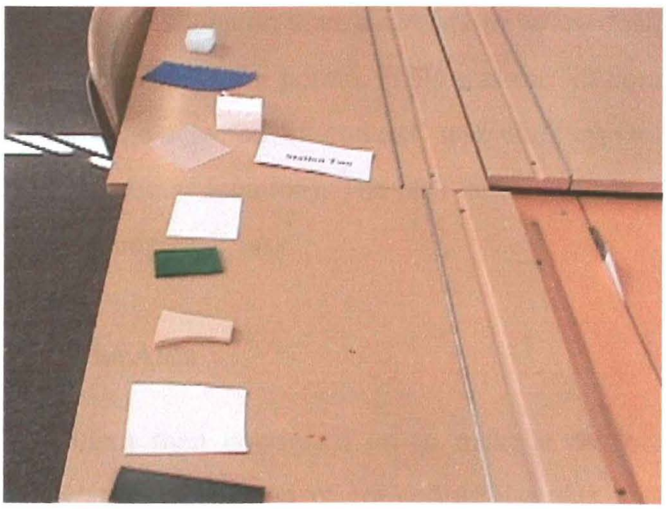
Station One set up. The hot soapy water is to come. You can see the small samples of the materials.

Station Two Durability

At Station Two the children took each material sample and tried to bend and tear it. The two questions they answered were:

Could the material be bent without damage?

Could the material be ripped?



Station Two shows the materials ready for bending and tearing

Station Three Stability

At Station Three the children decided if the material could be slid across a desk. They were asked to state:

Whether the material slid easily across the desk.

To conclude this activity each group of children discussed the materials they believed would be suitable for an aid for a one-handed person and why they would be suitable. On the recording sheet one member of the group recorded all answers (Appendix 15).

Categories for the Aids

Before planning their aid the children identified necessary and desirable categories for the aid. To do this they needed to recall knowledge from the above learning experiences to identify categories needed for the aid. Identified key categories could include such things as stability, sturdiness, wash ability, size, aesthetics, functionality and safety.

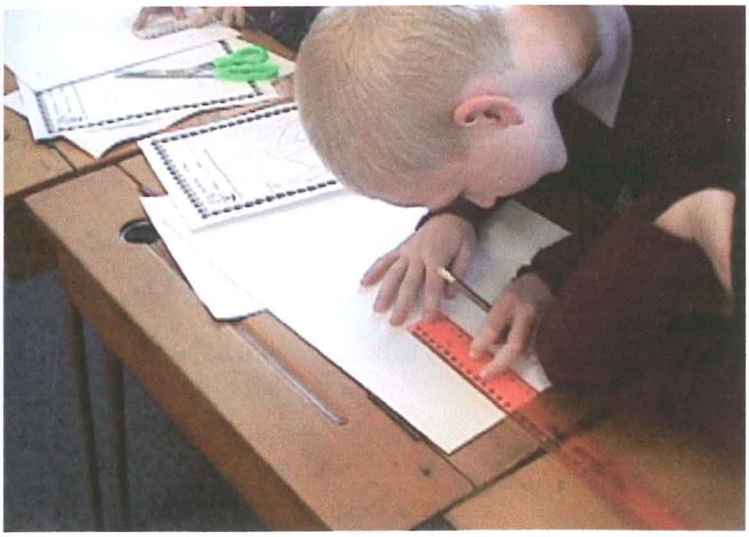
The Children's Plans

As individuals the children sketched two or three initial ideas in draft and selected one they intended to make. They either wrote or discussed why they selected their option and justified the selection to a teacher or a group of peers, clearly stating reasons for their selection of one over other designs.

Their selected ideas were then developed fully into an annotated plan of an aid. Plans included annotations on size, materials to be used and explanation as to how it might make it easier to peel a potato. (This was the 'in-context' task and it was at this stage that I took the selected 'in-context' task children from the room to complete the task for me in another location). The task and its administration were exactly the same as the 'out-of-context'' task.

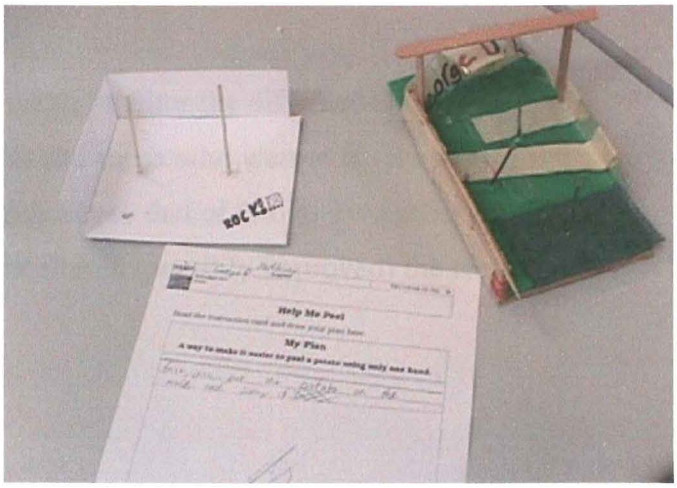
Making the Aids

The children then continued on to make a cardboard mock-up of their design. I demonstrated the process of converting the plan to a three-dimensional mock up. I showed the children how to measure the cardboard and cut it out, I also cut skewers to represent nails and modelled safe use of the hot glue gun. This made a significant difference to the children's approach. I did this because I could see that children were experiencing difficulty doing this.



After making their mock-up some children needed to modify their plans before they made the aids from the materials they had previously identified. Safe use of the hot glue gun and cutters was taught and monitored very carefully. The unit concluded with the children testing their aid by peeling a potato one-handed.

In this photo you can see a mock-up and the final design. The plan is in front. You can see this child has made considerable modifications between his mock-up and his final design



Considerations and Issues

There were a number of aspects I took into account when planning and researching this project. These included challenges for teachers in technology education, the sensitisation of subjects, researcher temptation to skew results, compensatory behaviour, time management, pupil behaviour, researcher relationships, validity, ethical considerations, parental permission, anonymity, triangulation, and variables.

Challenges for Teaching Technology Education

The teaching of technology remains problematic for a number of reasons. These include the newness of the subject. Teachers not only face difficulties in learning what and how to teach this curriculum area but also how to devise assessment activities. To overcome the issue of teacher confidence in technology education I introduced teachers to a new approach to assessment which showed key stages at which assessment might prove useful for teaching and learning. I identified these key stages and modelled discussion and intervention to show the value of teacher-child interactions for the successful completion of the set tasks.

Sensitisation of Subjects

One danger of this design was the possible *sensitisation* of the subjects who experienced the 'out-of-context' task and the 'in-context' task. A strategy I used to overcome the risk of sensitisation was careful selection of the children. I decreased the chance of the children being in both groups by using different categories for the selection of the children in the 'out-of-context' task to that used for selecting the 'in-context'.

The use of two groups of schools allowed me to monitor the difference between those classes involved in the 'out-of-context' task and those who were not. By comparing the 'in-context' task results in Group One schools to that of Group Two schools I was able to determine if the 'out-of-context' task altered (possibly improved) the results of the 'in-context' task.

Researcher Temptation to Skew Results

Another issue is the *temptation* for the researcher to skew results in favour of their desired outcome. I could have done this by giving the children completing the 'in-context' task more information or extra help so that their designs were of a higher standard. This was overcome by carefully following the NEMP guidelines for both the tasks. Once the task was completed I gathered in the children's plans. I photocopied them for the children so that they could use the copy to work from and modify if necessary. I used the originals for analysis, which wasn't done until all teaching was finished.

Compensatory Behaviour

Compensatory behaviour could also have been an issue for this research project. Compensatory behaviour can affect the dependent variable (Neuman, 2000). Compensatory behaviour in this project could have occurred by treating different classes in different decile bands differently. This was overcome in this study by the cooperative planning of the unit plan and the team teaching between the teacher and the researcher. Comments made in Interview Two confirmed that teachers kept to the planned unit.

Time Management

The issue that I was most aware of before this project began was my lack of time to be available to teachers in the classroom for the teaching of the unit. My timeline was tight and I needed to do the practical work in Term Two 2002. Unfortunately this also coincided with a heavy teaching load. This was overcome by flexibility of the teachers, which I greatly appreciated. They adapted their programmes to suit my timetable. In the end I was in the classrooms for most of the lessons up to and including the construction of the aid. Disappointingly I was unable to be in the classrooms when the children tested their aids. Unfortunately one school, School C, had a break of two weeks in the middle of the unit because of my time restrictions, however results indicate that this class was not disadvantaged because of this.

Pupil Behaviour

Another issue that was in the back of my mind was pupil behaviour while I was teaching particularly in the low decile schools where behaviour tends to be more of an issue. However such concern was unwarranted as the children responded well to the hands on nature of the unit and greeted me very enthusiastically whenever I entered the classroom.

Researcher Relationships

One of the difficulties that arose which I had not anticipated was the change in my relationship with the children between the 'out-of-context' task and the 'in-context' task. For the 'out-of-context' task I was unknown, a stranger, a person who was requiring them to do a task. Between the 'out-of-context' task and the 'in-context' task I became a familiar part of their classroom programme. The children associated my arrival in the classroom with practical, hands-on activity. Consequently by the time the 'in-context' task was completed about half way through the unit the children knew me as a teacher. During the 'in-context' task the children were more comfortable and asked more questions. I found it difficult not to give these children more information than the 'out-of-context' task children received.

Validity

Internal Validity

All primary schools in Christchurch were asked to participate in this project. The method of selection was not based on a relationship to technology. I was aware that schools who were keen to participate might reply early, this wouldn't necessarily mean they were more or less skilled in teaching technology, it might mean that they were efficient in administration tasks. Neuman (2000) states that internal validity is the means of eliminating alternative explanations of the independent variable. Relevant threats to the internal validity could have come through the *selection* process.

Safeguards

To ensure valid data, instead of using the NEMP results used in 2000, I administered the initial task 'out of context' in the same manner used in NEMP at the beginning of the study. This way the comparison results were taken from work completed in the same school term, with the same classes of children.

To ensure teachers did not overly influence the results of the 'in-context' task and /or alter their teaching to improve achievement in the 'in-context' task (compensatory behaviour, cited in Neuman, 2000) I played down the comparison section of the study to teachers. I discussed with the teachers a focus on how children learn in aspects of technology. For those classes involved in the 'out-of-context' task it was suggested that it would give an insight into the children before the unit is taught in the class. I said the focus of the study was to look at technology achievement levels of children in Year Four. I also said that half of the classes, one in each decile band were involved in the task before any teaching was done to give me an insight into the children and their thinking in each decile band. The same assessment task was used in all classrooms and was assessed for all the children using the NEMP aspects and categories with one exception referred to earlier in this chapter. This allowed for consistency of delivery.

I am aware that my bias may have been able to influence results of this study. I have in-depth knowledge of the task to be assessed and the intended purpose of the study. However I was not wholly responsible for the classroom delivery, as the teachers were directly responsible for the teaching of the unit in their classroom. I did not have the flexibility to change planned activities that may have impacted on child performance in the allocated task. The activities and the sequence of delivery were pre-planned and were adhered to.

External Validity

Selection of a range of schools from a range of decile rankings was made to improve the representativeness of the sample and therefore improved external validity. External validity increases the degree to which generalisations can be made from a particular experiment (Cohen & Manion, 1994). To further improve the external validity of this project the independent variable was clearly identified and described. As with internal validity sensitisation can affect external validity. By comparing results of Group One schools with the Group Two schools the level to which the children were sensitised to the task because of the out-of context task was determined.

Ethical Considerations

Two issues dominate ethics in traditional research of human subjects. One of these is voluntary participation of subjects or informed consent (R. Bogdan & Biklen, 1998; Mills, 2000). The other is that subjects are not exposed to any risks that are greater than any gains they may receive (R. Bogdan & Biklen, 1998). As a safeguard Mills

(2000) suggests confidentiality and anonymity. Anonymity should extend not only to writing but verbal reporting as well (R. Bogdan & Biklen, 1998).

Informed Consent

In my study research subjects, principals and teachers were approached in a manner that allowed for voluntary participation (Appendix 3).

Parental Permission

Before the technology unit began in the classroom, parents were informed of the project and asked for permission for their child to be used on the assessment tasks (Appendix 8). Parents were informed by way of a letter before the teaching of the unit began. Two schools, one middle decile and one low decile, had difficulty getting permission slips back from some Year 4 children. These children still participated in the unit as they would any other classroom unit, but they were not used in the 'out-of-context' or 'in-context' tasks. When this was the case I moved down the list until I had six children who had returned permission slips. This became a problem in one class that was a Year 3-5 composite class as there was only a small number of Year 4 children who returned permission slips. On the day of the 'out-of-context' test only five Year 4 children with returned permission slips were available.

Anonymity

At all times information gathered about the schools, teachers and students was kept confidential to them, my supervisors and myself. Teacher and student identity was protected at all times. In photographs that were taken, teachers and students' faces were not seen. Only the first names of children were used to identify subjects. Participating teachers and schools are referred to by code. All data gathered was kept in my office at the College of Education, which is always locked if I am not in it. Videotapes, interview tapes and transcripts were kept in my secure filing cabinet when not in use and destroyed on completion of the project.

Triangulation

In this research project data has been gathered from a variety of sources. It is accepted that in research researchers should not rely on one set of data (R. Burns, 1998; Mills, 2000). Triangulation contributes to the internal validity of the research project.

Exclusive reliance on one method may bias or distort the researcher's picture of reality. Triangulation enables researchers to check consistency of the findings between the different methods of data (R. Burns, 1998). The data in this project was evidence of the planned practice. The teachers' perceptions of the planned practice were recorded through the interviews. Both the teacher and I observed actual practice on an informal basis; this was recorded informally in my research journal. The second semi-structured interview supported evidence of the children's work and assessment data gathered and the actual practice. I experienced the teaching and learning by team teaching the unit with the teachers and finally I examined the data by assessing the children's performance on assessment 'in-context' tasks and comparing these with 'out-of-context' results.

Variables

The independent variable was the technology unit in which the children participated. The dependent variable was student achievement in the selected task. The 'out-of context' task is the measurement of the dependent variable prior to the introduction of the treatment (Neuman, 2000).

As the researcher I did not have total control over some aspects of the independent variable. Teacher approach and classroom hours spent on the unit are two aspects over which I had no control, however I minimised risk to the project by carefully planning a timetable with the teachers that allowed me to be in all of the classrooms most of the teaching time. The unit plan planned at the professional development day was written up in great detail so that there was little room for misinterpretation. Teachers commented to me in the second interview how detailed they thought the planning was and how easy it was to understand. I also ensured that all children completed the same activities carried out in the same way.

Summary

The focus of this chapter has been the method I have used to undertake this project. I also discussed how the schools and teachers were selected and how the unit planning process was used to scaffold teacher professional development in technology education. Implementation of the unit and the data gathering and analysis process were also discussed. The chapter concluded with a section on the issues identified and safeguards used during the project. In the following chapter the results of planning the task are presented, compared and analysed holistically, by task and by decile.

Chapter Four: Findings: Results

Introduction

Initially a holistic approach was taken with analysis of the total scores of the children and comparison between and within 'out-of-context' and 'in-context' task. This section is broken into several sections: overview of scores, sensitization of children because of the 'out-of-context' task, consistency of delivery across school, comparison of results between 'out-of-context' and 'in-context' and annotated examples- 'out-of-context'. This chapter includes further analysis of the children's results with a detailed breakdown of scores across each aspect. These are illustrated with annotated examples of the task, and indicate how they have been scored. Comparison of results across decile bands follows. This includes a look at total scores and further analysis of the different aspects across decile band. The chapter concludes with comment about how the professional development provided to the teachers influenced teacher knowledge and competency.

Overview of Total Scores in both Contexts

The overview of the total scores in both contexts is given to allow the difference in scores between the 'out-of-context' task and the 'in-context' task to be compared. It gives scores for each child and an average score for each school for both the 'out-of-context' task and the 'in-context' task. The scores are determined using the scored attributes (Figures 3.4-3.7) to each category within each aspect.

Assessment of the children's plans involved allocating points determined by NEMP to each of the four aspects. Within each aspect categories were given a point value related to the desirability of the features identified. More points were given for features which were more desirable, therefore a higher score indicated a better quality solution. Point values for each category are noted in Tables 3.4-3.7 in Chapter Three of this report. These points were accumulated to give individual children a total score for their plan. Scores for each school in both the 'out-of-context' and 'in-context' task were averaged.

Table 4.1 is an overview of each child's score in both tasks. Establishing the total scores of each school in both tasks allowed an immediate overview of the two sets of data. It also gave a clearer picture than just presenting the mean scores as it allowed the high and low scores to be considered. It also enabled me to see the degree of variability. For some schools their either high or low average score could be attributed to a single high or low score.

Table 4.1: ***Total scores for individual children, average total score for each school and the standard deviation***

	Out-of-context (Group 1)			**In-context**					
Schools	**School A**	**School C**	**School E**	**School A**	**School B**	**School C**	**School D**	**School E**	**School F**
Children	Aimee 3	Callum 4	Jolane 2	Francoise 17	Willem 11	Courtney 17	Matthew 17	James 15	Stacey 8
	Bridget 8	Billy 3	James 8	Meisha 16	Jason 10	Adam 11	Adam 16	Susie 9	Jonty 17
	Brittany 15	Kirsten 5	Hayley 10	Aimee 11	George 11	Ezra 17	Georgia 24	Nanami 17	Jacob 17
	Anna 19	Alex 3	Javarna 2	Georgia 10	William 2	Billy 16	Karwing 17	Renee 16	Georgia 1(
	Antonia 10	Courtney 3	Shakira 2	Brittany 17	Dylan 9	Callum 15	Holly 12	Toni 16	Sarah 11
	Annabel 6	Peter Absent	Samantha 2	Laura 17	Sam 17	Ashley 11	Cara 16	Oshiarne 17	Jordon 17
Average	10.20	3.60	4.30	14.66	10.00	14.50	17.00	15.00	14.33
SD	5.91	0.90	3.67	3.37	4.82	2.81	3.90	3.03	3.90

In the Group 1 schools for the 'out-of-context' task children in School A scored an average of 10.20; School C, 3.60 and School E, 4.30. School A was much higher than Schools C and E. The standard deviations showed a large deviation from the mean for School A, and to a lesser degree School E. Scores in School C showed only a small deviation. It was interesting to note that the highest scores in this task come from School A, the high decile school, Anna with 19.00 followed by Brittany with 15.00. School E, the low decile school, had four children score a low of 2.00: Jolane, Javarna, Shakira and Samantha.

In the 'in-context' task School A moved up to an average to 14.66, School C 14.50 and School E, 15.00. The Group 2 average scores were School B, 10.00; School D, 17.00 and School F, 14.50. Georgia, School D scored the highest score of 24.00 and William, School B scored the lowest score of 2.00. Standard deviations for this task were more consistent than above. School B had the highest standard deviation (4.82), again because of William's low score. Other standard deviations are within a narrow range from 3.03 to 3.90. It is interesting to note that excluding these two extreme scores, all other scores were within the range of 8.00 to 17.00. In the 'in-context' task School D scored the highest with an average score of 17.00, this was partly attributed to Georgia's high score. Four schools scored between 14.00 and 15.00 and School B scored the lowest average score of 10.00. This was partly attributed to William's low score also.

Sensitisation of Children in Group 1 Schools because of 'Out-of-Context' Task

To determine whether the Group 1 schools were sensitised by the instructional package, a comparison of the scores between Group 1 and Group 2 schools in the 'in-context' task was undertaken. If significantly different I determined that the Group 1 schools were sensitised by the instructional package (teaching the unit).

There were two ways in which the children might have been sensitised. The first on a general level might have occurred if the children who performed the 'out-of-context' task discussed the task with their peers, who may have then done some informal research on the subject. The second level was more direct and may have occurred if the children were picked to do both the 'out-of-context' task and the 'in-context' task. There were six children in this category: Aimee and Brittany from School A, Billy, Courtney and Callum from School C and James from School E.

To determine if the children were sensitised to the task I compared the 'in-context' task scores of Group 1 schools with Group 2 schools. If the children had been sensitised by the 'out-of-context' task I would expect to find their achievement to be significantly higher than those in Group 1 because they may have had the opportunity to do extra study or investigation other than that offered in the treatment (unit). If the children were not sensitised by the 'out-of-context' task I would expect to see no difference between their achievement levels and that of the children in the Group 2 schools. A comparison of the mean scores and standard deviation of scores for Group 1 and Group 2 revealed no significant differences ($t = 0.70$ $p > .05$). The p- value gave the probability of a real difference and to be significant it would needed to have been less the 0.05. (See Table 4.2)

Table 4.2 ***The mean and standard deviation scores for the 'in-context' task.***

	Mean	Std. Dev.	N	t
Group 1	**14.7**	**2.86**	**18**	**0.70**
Group 2	**13.8**	**4.95**	**18**	

There was no significant difference between Group 1 and Group 2 scores suggesting that the Group 1 children were not sensitised by the 'out-of-context' task. Both groups (all schools) were therefore treated as one group in the 'in-context' task for further analysis.

To determine whether those children who performed the task twice were advantaged I compared their average scores of the 'in-context' task with those of the others who did not (see Table 4.3)

Table 4.3 ***'In-context' scores of children who took both tasks and average scores of children who took only the 'in-context' task***

Child	**Score in 'In-context' Task**	**School**	**Average Score of Other Children in that school for 'In-context' Task**
Aimee	11	School A	15
Brittany	17	School A	15
Billy	16	School C	13
Courtney	17	School C	13
Callum	15	School C	13
James	15	School E	15
Average	**15.16**	**Total Average**	**14.25**

One child scored lower than the class average (Aimee) for the 'in-context' task and one child scored the same as the class average (James). Three children were two to three points above their class average and one child (Courtney) was four points above her class average. The total average score for the children who repeated the task was less than one point above the average score of children who only completed the task as an 'in-context' task. The data suggested that the difference here was not enough to be of concern. I don't think the children who completed the task twice were significantly advantaged because they completed the task for the second time.

Consistency of the Delivery across Schools

To determine if the programme was delivered consistently across all classrooms a comparison of scores between all schools in the 'in-context' task was undertaken. This was also backed up by teacher comments from Interviews One and Two about their intended and actual practice. This was important because the study combined the results of six schools for analysis of the 'in-context' task. It also compared the results across schools for information of decile difference. For these comparisons to be valid delivery in each school needed to be consistent. To do this I compared all schools' 'in-context' scores. Mean scores and standard deviations were calculated for each, p was calculated to be 0.08 ($F=2.34$; $df=5,30$; $p> 0.05$). This established that there was no difference between the schools for the 'in-context' task, which suggested that a consistent programme was offered to them (See Table 4.4).

Table 4.4 *The mean and standard deviation of scores for the 'in-context' task*

	Mean	**Std. Dev.**	**N**	**F-value**
School A	**14.7**	**3.27**	**6**	**2.34**
School B	**10.0**	**4.82**	**6**	
School C	**14.5**	**2.81**	**6**	
School D	**17.0**	**3.90**	**6**	
School E	**15.0**	**3.03**	**6**	
School F	**14.3**	**3.89**	**6**	

Interview Two comments also confirmed that intended practice (the planned unit) was adhered to during implementation.

> We pretty much stuck to the plan and all of the children have produced their aids, which are really good. We were actually surprised at the number of different designs that the children came up with which I was very pleased with and so were the children when they look at what they has done and you could see them processing and thinking (Interview Two, Teacher C, 13 June 2002).

> I think we followed, I followed very closely the plan you gave us that we had (Interview Two, Teacher B, 28 May 2002).

> Basically we went through it by the plan. Pretty much the same really (Interview Two, Teacher D, 6 June 2002).

> I do not think we changed the order around from memory (Interview Two, Teacher E, 17 June 2002).

Given these analyses I concluded that the treatment given to all schools was equivalent and therefore I could use the scores from all schools in the analysis of the 'in-context' task for the comparison between the two contexts.

Comparison of the 'In-context' Task Scores

To allow comparison with the 'in-context' scores, overall results of the 'out-of-context' task are included. To illustrate the differences between high and low scoring plans, the 'out-of-context' task annotated examples are also included, there are six shown; the three lowest scores and the three highest. Annotations about each aspect of each plan allow a clear comparison and indicate the process and thinking I went through when scoring the plans.

The focal point of this study was the comparison of children's achievement and its relationship to a given technological practice context. Having established the above I was able to determine if the instructional package I taught during this project made a difference to achievement levels of the children between the 'out-of-context' task and the 'in-context' task. To establish this across all schools I compared the 'out-of-context' task scores to the 'in-context' task scores (see Table 4.5). Table 4.5 shows the mean and standard deviation of scores for both the 'out-of-context' task and the 'in-context' task.

Table 4.5 ***Mean and standard deviation of scores for the 'out-of-context' task and the 'in-context' task.***

	Out-of-context Task	**In-context Task**
Mean	**6.18**	**14.25**
Std. Dev.	**4.97**	**4.01**
N	**17**	**36**
t	**-6.33**	

Results showed that there was a 99% chance that the difference between the two sets of scores was a real difference, ($t = -6.33$; $p < 0.01$) therefore the difference was significant at 0.01. There was very clear evidence of this improvement both in the analysis above and looking at the actual plans completed by the children for the task. The changes in the children's performance were as a result of the instructional programme planned and implemented by the teachers and me. However there was a possibility that the improvement overall might be attributed to some of the aspects used in the assessment of the children's plans and not others.

Analysis by Aspect

To determine whether the instructional package affected achievement levels of students, the 'out-of-context' task scores and the 'in-context' task scores across all schools were compared to see if the percentages of children who have scored in each aspect changed from one context to another.

In the following three sections I investigate the children's plans further, looking at examples of the children's work to highlight the different aspects and how and why they were scored. In the 'Nature of Solution' aspect children may have been credited with more than one category. In other words their plans may have been credited for both 'holding the potato still' and 'machine'. For the other three aspects each child's contribution was scored on only one category, for example a plan was either 'detailed' or 'rudimentary'.

In the first section I explored the 'out-of-context' task. Three examples of low scoring plans and high scoring plans were selected and included. Each has been annotated, giving information on the score given in each aspect and why. In the second section each aspect was introduced with a graph which compared the percentage values given in each category for both tasks. I also investigated the children's planning from the 'in-context' task. For this section a slightly different approach has been used. Because I had a greater number of examples I was able to pull out low and high scoring plans for each aspect. The difference in scoring was much more evident and this method allowed me more discussion about each aspect. The third section compares the results across decile band, again looking at each aspect. The rationale for this was to determine whether particular aspects were more affected by decile bands than others.

Results of 'Out-of-context' Task

In the 'out-of-context' task for the quality of the idea/solution 76% of children scored 'possibly workable' or 'not workable'. Only 18 % were 'clearly workable' and 6% were 'probably workable'. In the aspect 'quality of plan/ diagram/ picture' 100% of responses were 'rudimentary' and with 82% of their explanations being of 'rudimentary' quality also. This planning category was totally independent from the feasibility of the plan offered. In the nature of the solution aspect 33% of responses indicated a way of holding the potato still, 12% indicated a way of holding the aid still with 47% of responses not offering a workable solution. 18% of children identified a machine to do the job.

Table 4.6 ***The percentage of children who scored in each category in the 'out-of-context' task by aspect***

Aspect	Clearly Workable	Probably	Possibly	Not Workable
Quality of Solution	18	6	29	47

Aspect	Detailed	Rudimentary	No Solution/ Plan/ Explanation
Quality of Plan	0	100	0
Quality of Explanation	18	82	0

Aspect	Holds Potato still	Holds aid still	Holds Peeler still	Machine	Person Helping	No solution
Nature of Solution	33	12	0	18	6	47

On the following pages are the three lowest scoring plans and three highest scoring plans for the 'out-of-context' task group. By coincidence the three lowest scoring plans are by children all from School E, the low decile school in the 'out-of-context' task group (Group 1) and the three highest scoring plans are by children from School A, the high decile school in the 'out-of-context' task group. This difference across decile for this task will be discussed later. The plans are annotated and give the categories attributed to each design in each aspect. There is also a brief explanation as to why the categories have been attributed. Arrows have been added where applicable to point out features mentioned.

To compare the 'out-of-context' task and the 'in-context' task by total scores and aspect a graph portrays the results for each aspect. These results are of major significance for this project. They determine whether student achievement in technology is higher within technological practice (in-context) than 'out-of-context'. These results give the percentage of children who score in each aspect in each category. (See Appendix 18 for all results). There is also an annotated low and high example in each aspect form the 'in-context' task. The annotation gives insight into how I applied the categories and assessed the children's plans.

Annotated Examples of 'Out-of-context' Tasks

Low Scoring Plans from the 'Out-of-context' Task

Figure 4.7 ***Shakira, School E, scored a total of 2 points***

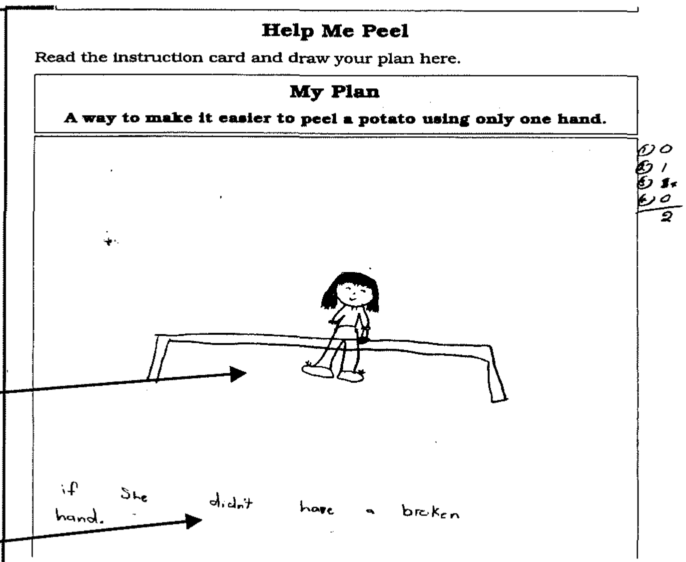
Aspect One
Quality of Solution

Unworkable solution

This plan was not considered a solution within the context of the identified need

Aspect Two
Quality of Plan
Rudimentary picture with
No information drawn

Aspect Three
Quality of Explanation
Rudimentary
Explanation not relevant to the design



if she didn't have a broken hand.

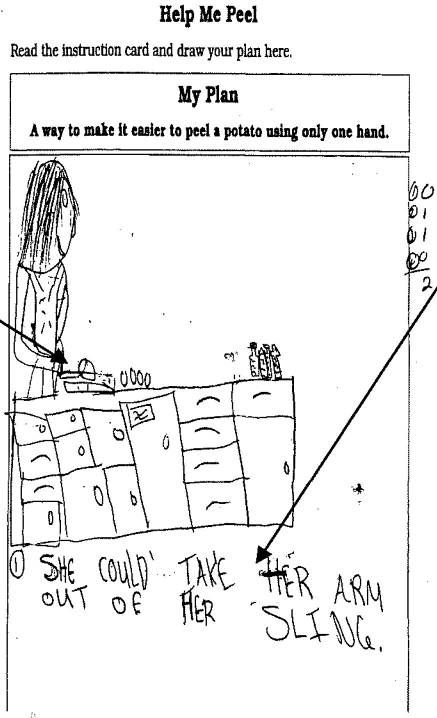
Aspect Four
Nature of Solution
Solution offered unrealistic for the intended purpose

Figure 4.8 *Samantha, School E, scored 2 points*

Aspect One
Quality of Solution
Unworkable solution

This plan was not considered a solution within the context of the identified need

Aspect Two
Quality of Plan
Rudimentary
No annotations
No measurements



Aspect Three
Quality of Explanation
Rudimentary
Explanation not relevant to the design

Aspect Four
Nature of Solution
Solution offered unrealistic for the intended purpose

Figure 4.9 *Javarna, School E, Scored 2 points*

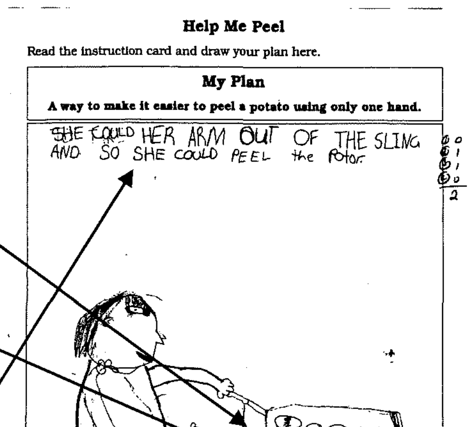
Aspect One
Quality of Solution

Unworkable solution

This plan was not considered a solution within the context of the identified need

Aspect Two
Quality of Plan
Rudimentary picture with
No information drawn

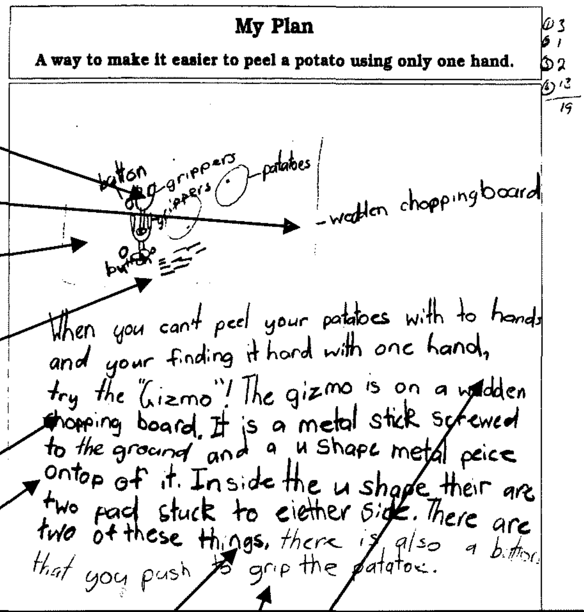
Aspect Three
Quality of Explanation
Rudimentary
Explanation not relevant to the design



Aspect Four
Nature of Solution
Solution offered unrealistic for the intended purpose

High Scored Plans from the Out-of-context Task Group

Figure 4.10 ***Anna, School, A Scored 19 points***



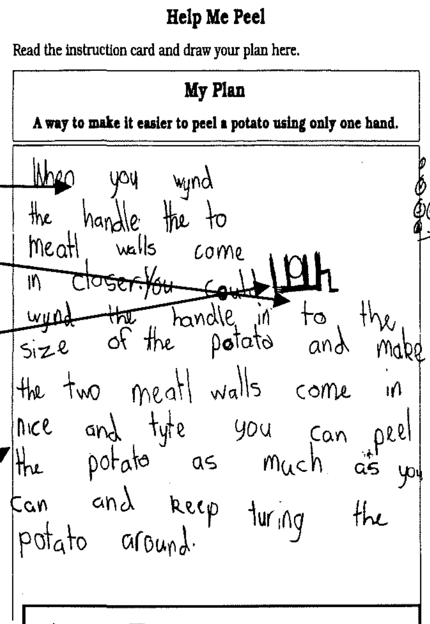
Aspect One
Quality of Solution
Clearly workable, kept the potato still
Aid is on a chopping board

Aspect Two
Quality of Plan
Rudimentary
No measurements
Some annotation
Very small

Aspect Three
Quality of Explanation
Quite Detailed
Discussed how to peel the potato
Plan information expanded
Gripping the potato explained

Aspect Four
Nature of Solution
Credited with
Way of holding a potato
Way of holding the aid still- not fully explained but I thought it was implied because of the chopping board
Will use electricity

Figure 4.11 ***Antonia, School A, Scored 10 points***



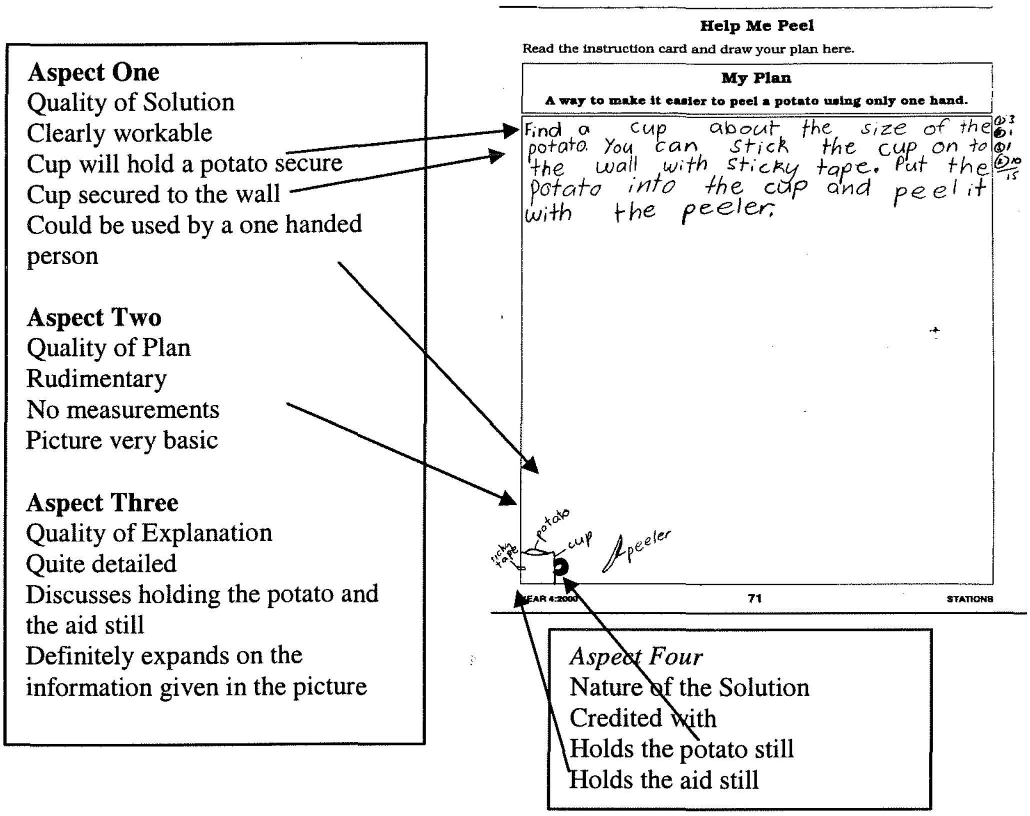
Aspect One
Quality of Solution
Probably workable
Keeps the potato still
Not secured to bench
Size and materials not stated
Could be used by a one handed person

Aspect Two
Quality of Plan
Rudimentary
No annotation
Very small
Basic picture

Aspect Three
Quality of Explanation
Quite detailed
Discusses how it will make peeling a potato easier
Expands on information portrayed in the picture

Aspect Four
Nature of the Solution
Credited with
Holds the potato still

Figure 4.12 *Brittany, School A, Scored 15 points*



It can be seen from these examples above that the quality of the solutions lacked practicality and focus on the actual aid in the low scoring examples. These children have focused on the child rather than the aid. It was also clear from the examples that the high scoring and the low scoring plans lacked detail and annotation. Many were small, none had measurements, two of the low scoring plans were pictures of the girl peeling potatoes with no aid evident. The high quality plans discussed the aid and were similar to the 'in-context' explanations. The low scoring explanations didn't relate to the aid at all, but suggested the best option was either to remove the sling or fix the broken arm. These explanations did not help solve the given problem. The low scoring plans did not offer a feasible solution to the identified problem. The high scoring plans did consider the problem but lacked practicality and detail.

'In-context' Task

'In context' results have been presented in a different format to those of the 'out-of context' tasks because of the increased number of examples I was able to find different examples for each aspect. This also enabled me to determine whether one aspect was more influential on the improved overall result than others. Table 4.13 gives an overview of scores for the 'in-context' task, higher scores were evident immediately.

In the 'in-context' task only 3% of solutions offered were 'unworkable' and 8% ranked 'possibly workable', 11% in total. 67% of solutions offered in the 'in-context' task were 'workable' and 22 % were 'probably workable', totaling 89% in the top two categories. 67% of planning was 'detailed' and 33% was 'rudimentary'. Rudimentary explanations counted for 25% and detailed explanations for 75%. In the 'nature of the solution' category, 86 % of responses mentioned a way of holding the potato still and 69% mentioned a way of holding the peeler still. Only 3% were machines, 3% offered an unworkable solution and 3 % mentioned a way of holding the peeler. Table 4.13 shows these results.

Table 4.13: ***The percentage of children who scored in each category in the 'in-context' task by aspect.***

Aspect	Clearly Workable	Probably	Possibly	Not Workable
Quality of Solution	67	22	8	3

Aspects	Detailed	Rudimentary	No Solution/Plan/ Explanation
Quality of Plan	67	33	0
Quality of Explanation	75	25	0

Aspect	Holds Potato still	Holds aid still	Holds Peeler still	Machine	Person Helping	No solution
Nature of Solution	86	69	3	3	0	3

Comparison of 'Out-of-context' Results to Task 'In-context' Task Results

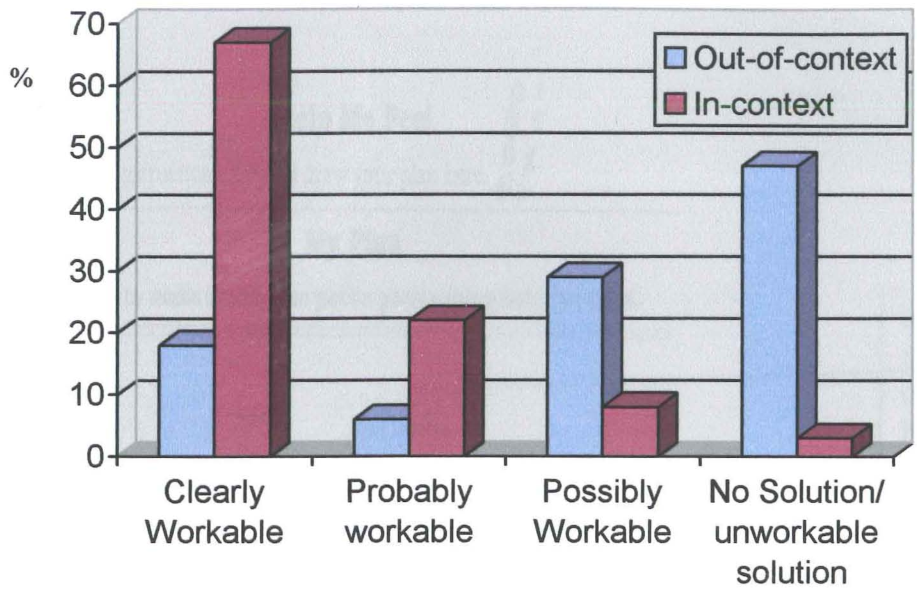
In the following section each category in each aspect has been presented in a bar graph for comparison of the two task contexts (out-of-context and in-context) for the task. These results compare the total percentage of children who scored in each of the categories in each aspect. I have also included a high scoring and low scoring example in each aspect for the 'in-context' task. All examples are annotated and indicate how and why they were scored.

Tabulated percentage frequency distributions with bar charts were used to present these results. Data gathered from the interviews was used to back up statements made about intended and actual practice, teacher attitudes towards the professional development and attitudes of the children to the unit.

Quality of the idea/solution-Its workability

Figure 4.14 compares the scores in the quality of the solution offered. That was the likelihood of the designs planned and explained by the children actually being able to aid a one handed person to peel a potato by themselves. Compared to the 'out-of-context' task there was a big increase in the number of children who presented a 'clearly workable' design and a significant decrease in the number of children who produced an 'unworkable solution' in the 'in-context' task. In the 'in-context' examples given both solutions considered aspects of stability for the potato. The high scoring example also considered stability of the aid.

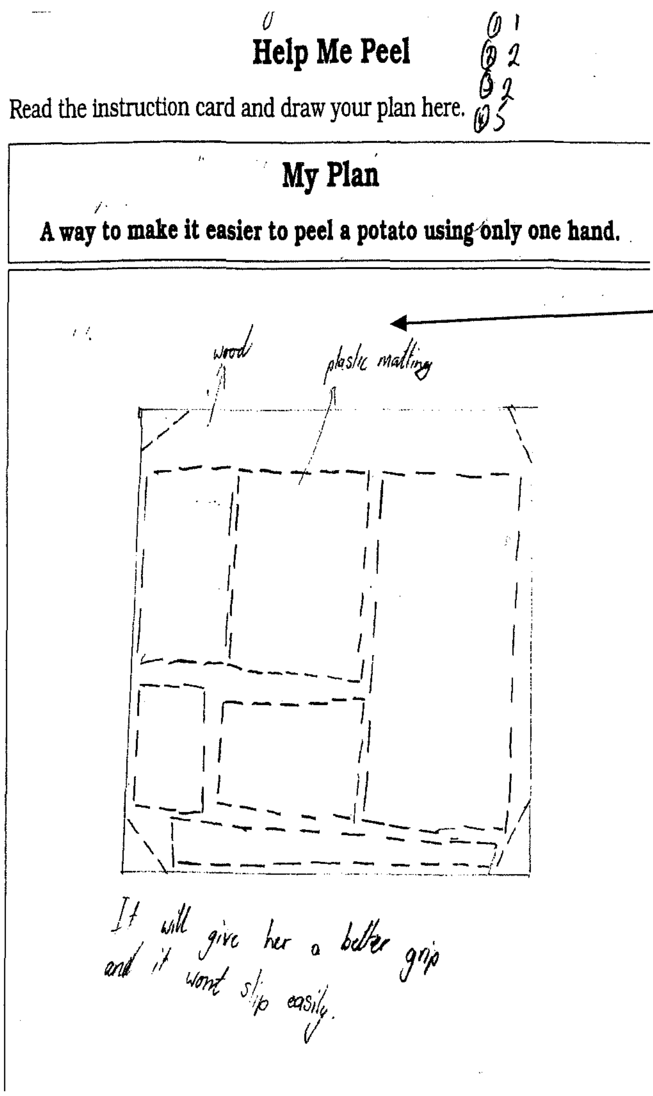
Figure 4.14 ***Percentage of children who scored in each category of Aspect One Quality of the Idea/ Solution-Its workability by context of Task***



It is clear to see that there was a marked increase in the plans that were 'clearly workable' between the 'out-of-context' task and the 'in-context task. Inversely there was a decrease in the number of plans that were unworkable or offered no solution between the 'out-of-context' task and the 'in-context' task.

Examples of Work in Aspect One

Figure 4.15 ***Aspect One :Quality of the Idea/ Solution-Its workability***
Low Score: Jason, School B, Scored 1 Possibly Workable


Help Me Peel

Read the instruction card and draw your plan here.

My Plan

A way to make it easier to peel a potato using only one hand.

wood

plastic matting

It will give her a better grip and it wont slip easily.

Keeping the potato still considered but not likely to be very successful.

Didn't mention holding the aid still

Design may possibly work

Figure 4.16 ***High Score: Oshiarne, School E, Scored 3- Clearly Workable***

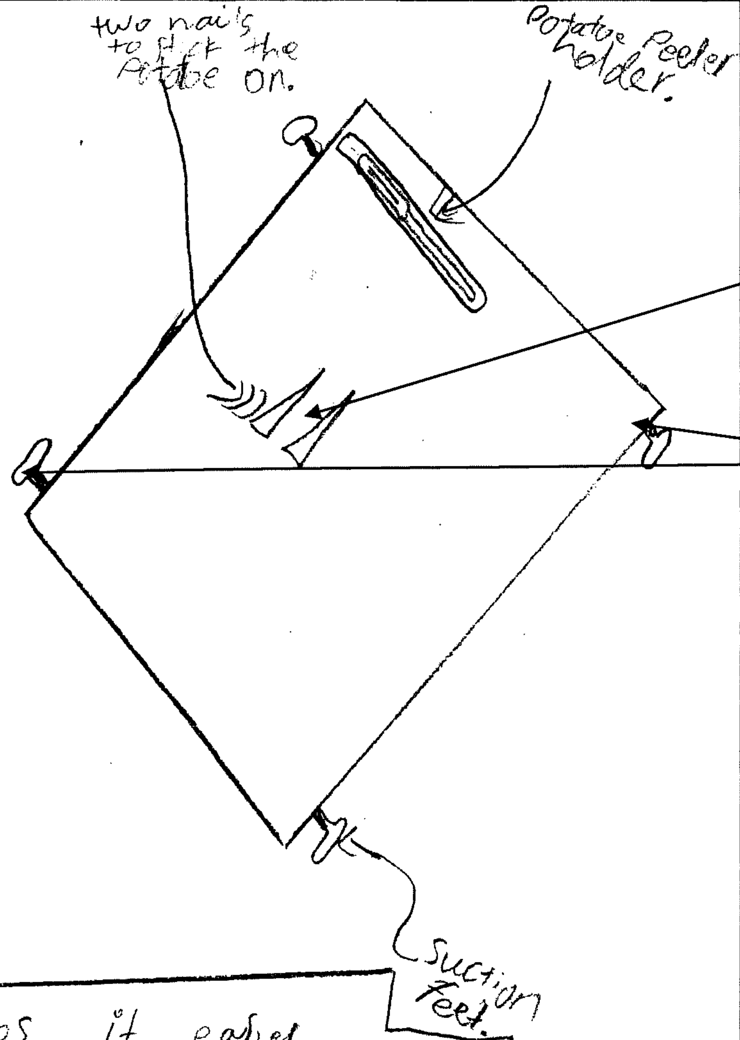
Help Me Peel

1 3
2 2
3 2
4 10
17

Read the instruction card and draw your plan here.

My Plan

A way to make it easier to peel a potato using only one hand.



It makes it easier because the potatoe doesn't move and the board.

The solution offers a way to keep the potato still

Offers a way to secure the aid

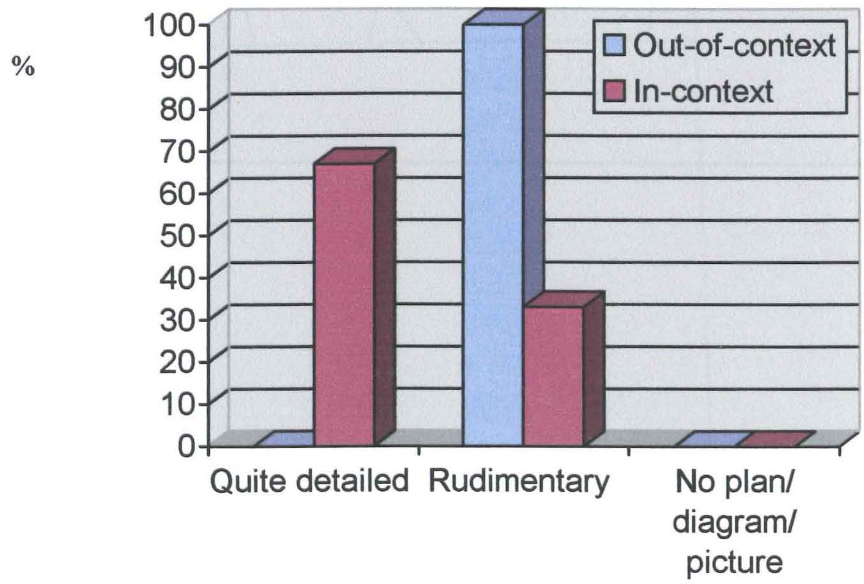
Could be used by a one handed person.

Quality of Plan/ Diagram/ Picture

Figure 4.17 compares the scores of the 'out-of-context' task to the 'in-context' task in the category quality of the plan/ picture/ diagram. This was totally independent of its workability. This meant that detail of planning, quality and clarity of the diagram and whether the design was annotated or not were assessed as opposed to whether the plan represented a "successful" solution to the problem.

The quality of the plan, picture or diagram in the 'in-context' task produced 67% 'quite detailed' plans and 33% of 'rudimentary plans'. No children in the 'out-of-context' group provided detailed plans, 100% of their plans were rudimentary.

Figure 4.17 *Percentage of children who score in each category of Aspect Two-Quality of Plan / Diagram / Picture by context of Task*



The 'in-context' examples illustrated clearly the difference between a low and high scoring plan. Although both were of a good size (an improvement on the 'out-of-context' plan) the low scoring plan had very little detailed information only mentioning one material and not stating if it is for the whole aid or just one section. It was very basic, included using the side of the page as a part of the plan. The detailed plan, on the other hand attempted to give a three-dimensional effect, gave measurements and mentioned a range of materials to be used.

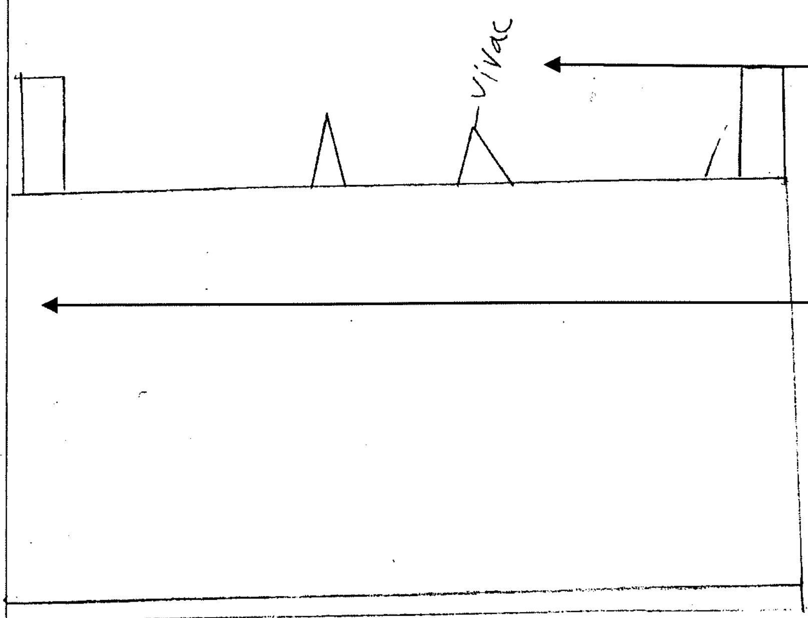
Examples of Work in Aspect Two

Figure 4.18 *Aspect Two: Quality of the Plan*

Low Score: Dylan, School B, Scored 1- Rudimentary

My Plan

A way to make it easier to peel a potato using only one hand.



Very basic plan

Very little information

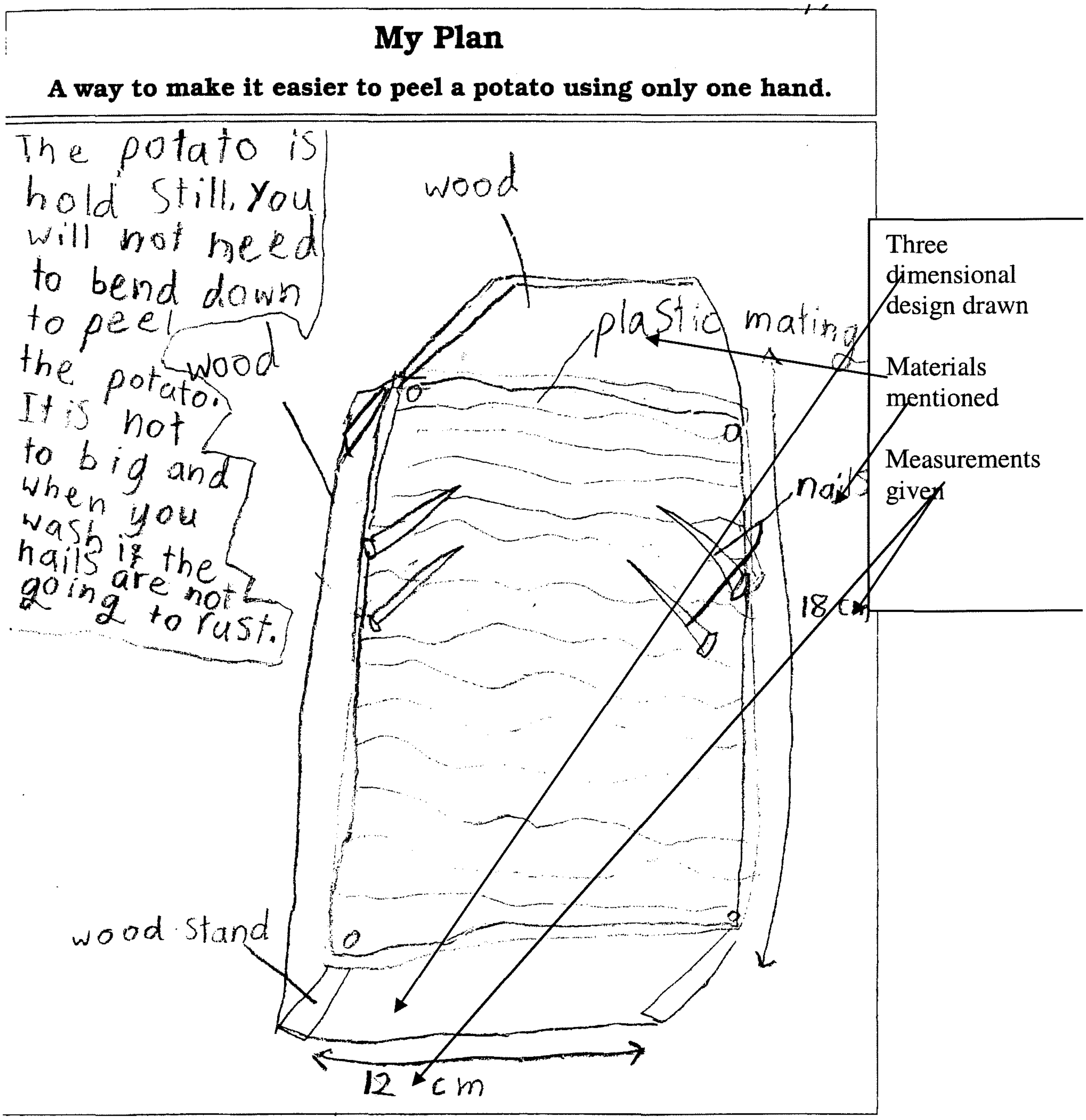
One dimensional

Used the side of the given box as a side

I will hold it for you, one was for you.

Figure 4.19 *Aspect Two: Quality of the Plan*

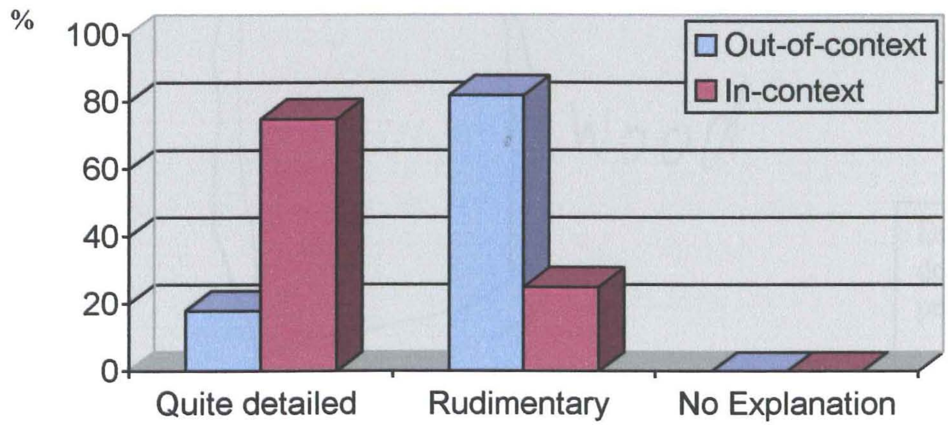
High Score: Matthew, School D, Scored 2- Quite detailed



Quality of Explanation

Figure 4.20 compares the scores of the 'out-of-context' task to the 'in-context' task in the Aspect 'Quality of Explanation -independent of its workability'. This meant that detail of written explanation that accompanied the planning was assessed for clarity and detail and whether it expanded on the information given in the planning as opposed to whether the explanation described a "successful" solution to the problem.

Figure 4.20 *Percentage of children who scored in each category of Aspect Three* ***Quality of Explanation*** *by context of Task*

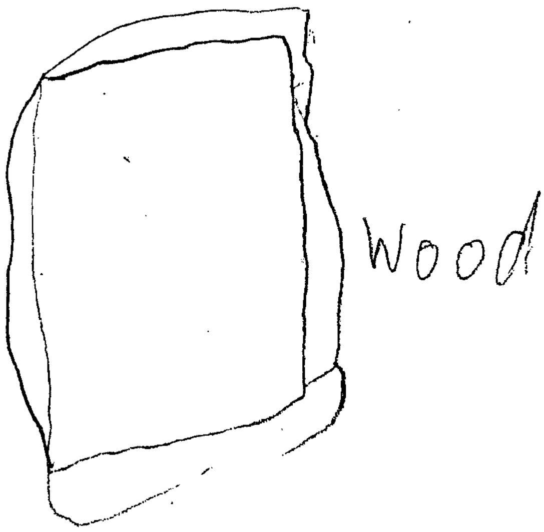


The quality of the explanation offered by the children in the 'in-context' group was quite good, 75% of children produced a quite detailed explanation. This was an improvement from the 'out-of-context' task where only 18% offered a detailed explanation. The number of 'rudimentary' explanations clearly decreased between 'out-of-context' and 'in-context' tasks. For the 'in-context' group the rudimentary explanation gave very little detail and would not give much help to another person trying to build from the plan. On the other hand the detailed explanation described how the aid worked and also made clear links to the pre-identified categories of keeping it clean and putting it away.

Examples of Work in Aspect Three

Figure 4.21 ***Aspect Three: Quality of the Explanation***

Low Score: Stacey, School F, Scored 1- Rudimentary



The Sids helps by wood

Does not discuss how the design makes it easier to peel a potato

The explanation does not expand on the information given in the plan.

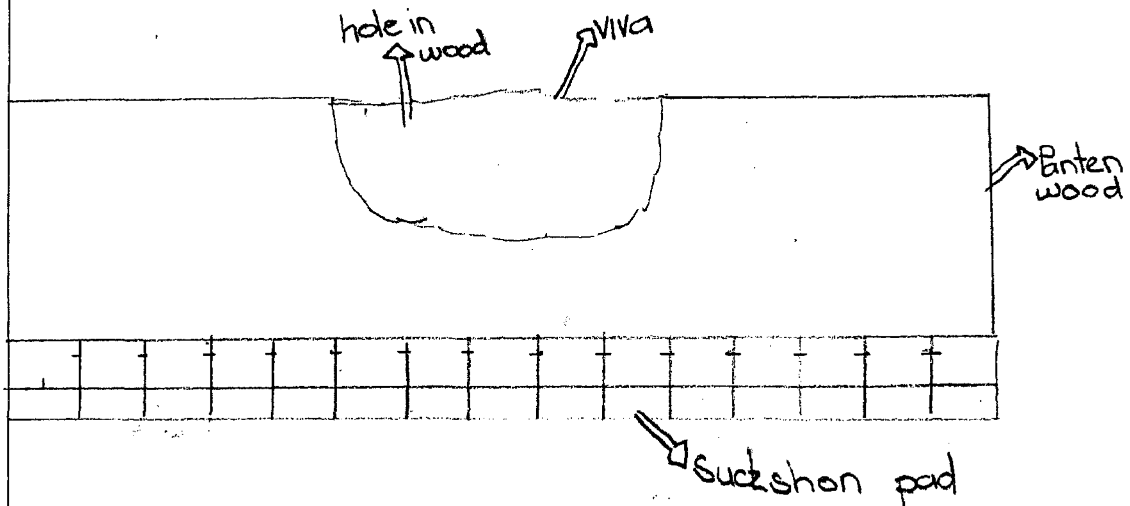
Little information given about the design

Figure 4.22 *Aspect Three: Quality of the Explanation*

High Score: Laura, School A, Scored 2- Quite detailed

My Plan

A way to make it easier to peel a potato using only one hand.

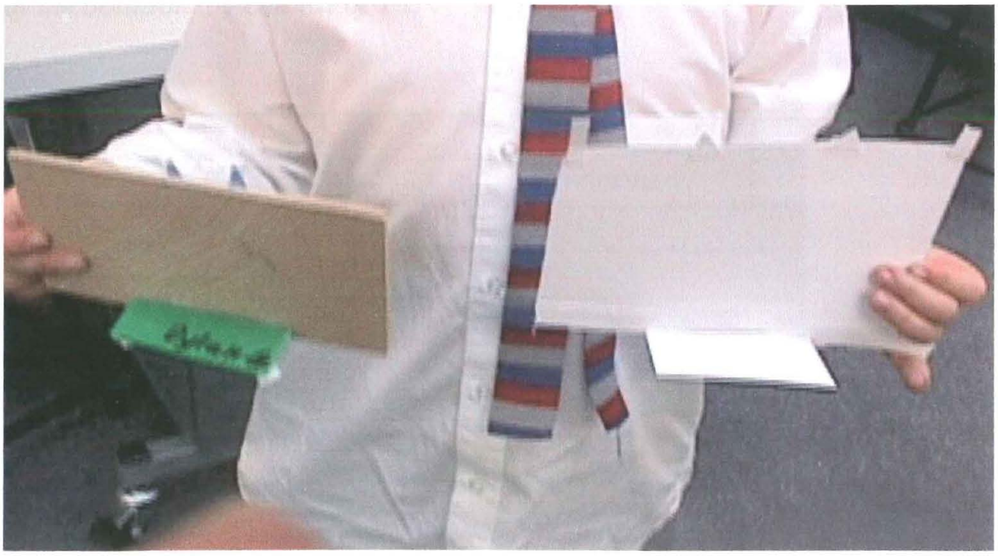


This makes it easyer to peal a potato
Because:
The potato stays still in the hole
The suckshon pad keeps the wood still
The viva keeps the aid clean while not used
The aid can be cleaned with water
You can put it away

Explanation expands on the information given in the plan

Discusses how the plan makes it easier to peel the potato

Jason, School B, shows his cardboard mock-up on the right and his final design on the left (plan Figure 4.18).

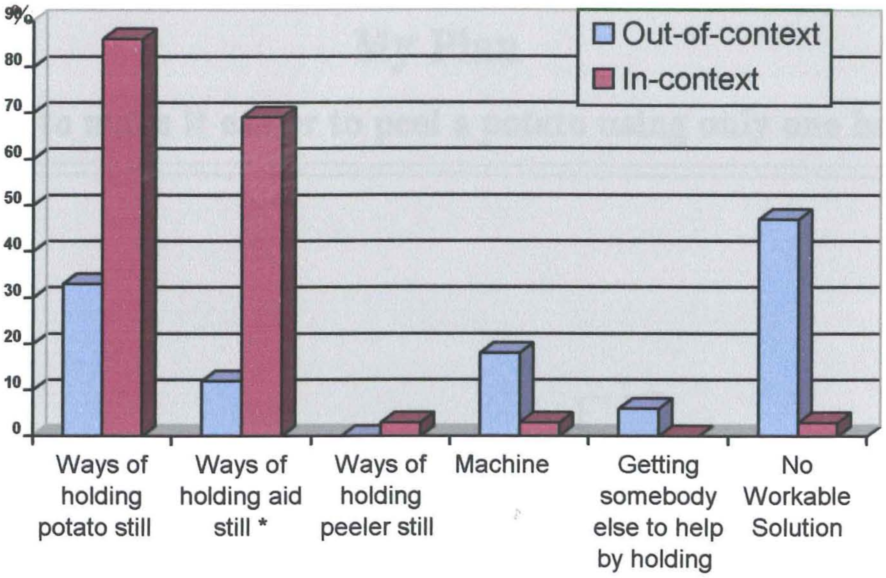


The Nature of Solution

Figure 4.23 compares the nature of the solution. The nature of the solution actually looks at the design and what it has to offer. For an aid for a one-handed person the design either needed to stabilise the potato or the blade of the peeler so that the potato could be peeled. The second of these was considered less desirable because the picture given to the children in the task showed a girl attempting to peel a potato with a common variety of plastic peeler-hence the lower score attributed to this category. The aid itself also needed to be stable as pressure is exerted against the aid and the potato when peeling is taking place.

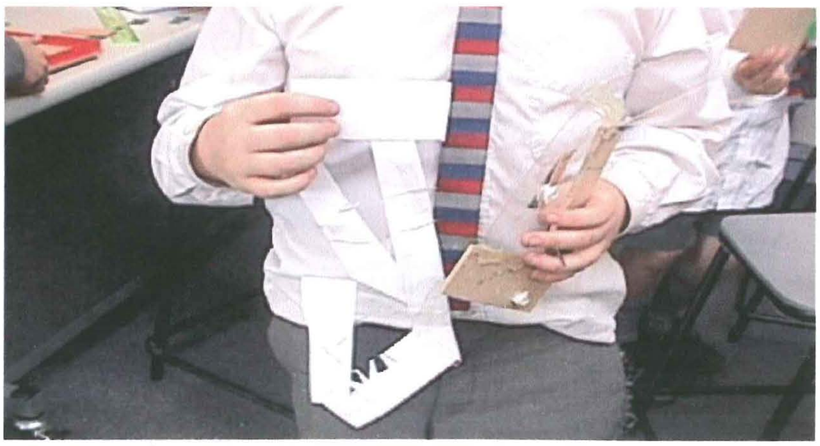
Children in the 'in-context' group scored highly in the highest two categories, 86% were accredited for 'holding the potato still' and 69% 'holding the aid still'. This was considerably higher than for the 'out-of-context' group. Another significant change to note is the decrease in children who drew a machine between the 'out-of-context' group 18% and 'in-context' group 3%. Solutions in the 'in-context' group were more likely to be able to be made by the children themselves.

Figure 4.23 *Percentage of children who scored in each category of Aspect Four The Nature of the Solution by context of Task*



This graph clearly shows a sharp increase in the children who identified a way of holding the potato still and the aid still between the 'out-of-context' task and the 'in-context' task.

William, School B, shows his mock up in cardboard in the right and his final design on the left (plan on the following page, Figure 4.24)

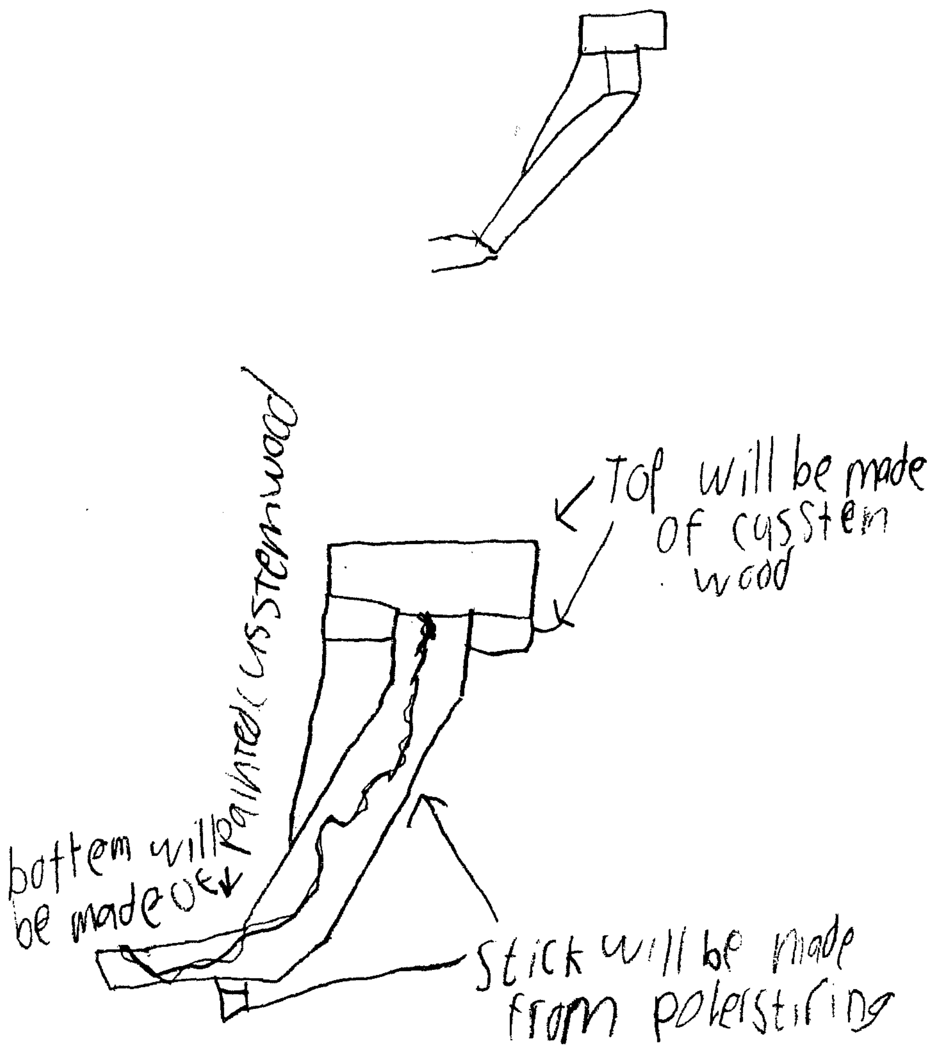


Examples of Work in Aspect Five
Figure 4.24 ***Aspect Four: Nature of the Solution***

Low Score: William, School B, Scored 0 - No workable solution

My Plan

A way to make it easier to peel a potato using only one hand.



I is stronger than the the otherones:

Solution unable to be made with information given

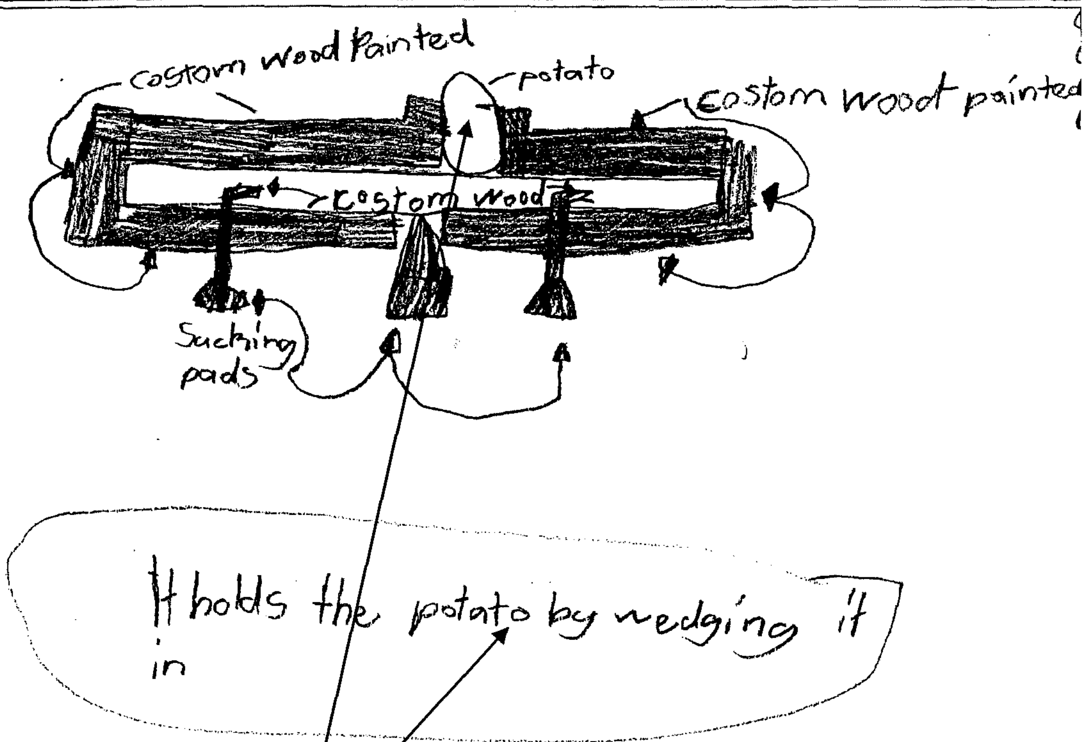
Child's intentions not clear

Figure 4.25 *Aspect Four: Nature of the Solution*

High Score: Billy, School C, Scored 10 - 5 for keeping potato still and 5 for keeping aid still

My Plan

A way to make it easier to peel a potato using only one hand.



Billy was credited with designing a way to hold the potato still

And he was also credited with including features to hold the aid still

The solutions in the 'in-context' still offered a full range of solutions. This range was well illustrated in the included examples. William's low scored solution does not reflect much of the learning that occurred in the unit. You can see from the plan and photograph of this design that William could not convert this image from two-dimensional to three-dimensional. It is difficult to see from his design exactly how he thought it would work. He was the only child who said he would use polystyrene ("polerstiring") on his plan. In fact he used Vivac. It was obvious from the plan that William's design would not work. Billy's high scoring solution was much more complex in design and included main features required of an aid. He offered ways to keep the aid and the potato still and secure. Materials had been considered and linked to the investigation undertaken by the children. Billy's plan was a cross section view; to improve the quality of his explanation he could have mentioned this. The fact that he didn't caused some problems during the construction of the aid.

Summary of Comparison

In summary the results showed a consistent increase in achievement between the 'out-of-context' task and the 'in-context' task across all aspects. All categories showed a marked difference in results except the 'No Solution' category of Aspects Two and Three where all results remained at 0%. Aspect Four offered a number significant differences with the decrease from 47% to 3 % of children who offered no solution, and increase from 33% to 86% of children who offered a way of holding the potato still. In the category 'holding the aid still' there was an increase from 12% to 69% between the 'out-of-context' task and the 'in-context' task. Another exciting difference was the increase in 'detailed plans' from 0% in the 'out-of-context' task to 67% in the 'in-context' task. The aspect with the least dramatic difference was Aspect Three-Quality of the Explanation. This may be attributed to the fact that the children may still have offered an explanation which supported their plan even if the plan of the solution was not of a high quality. Literacy levels may have also impacted in this aspect more than the others.

Achievement Differences between Decile Bands

To determine whether there were differences in the achievement of children in different decile bands I included a comparison of the differences between schools in each decile band by comparing the 'out-of-context' scores of Group 1 schools with each other, across decile band and comparing scores of across each decile band for the 'in-context' task for all schools. From this I determined whether overall results differed between the decile bands for both the 'out-of-context' task and the 'in-context' task.

In NEMP *Aspects of Technology* 2000 for Year 4 children there were differences in achievement between decile bands for 19 of the 22 tasks, with the lowest decile band performing worst (Crooks and Flockton 2001). For this reason I selected two schools from each decile band. In this project performances between decile bands were compared. One class from each decile band made up the Group 1 schools completing the 'out-of-context' task. Another school in each decile band (Group 2) joined the Group 1 schools to complete the 'in-context' task.

Out-of-context Task

Comparison of the Group 1 schools in the 'out-of-context' task determined whether there was a difference in scores across decile band. Analysis of variance revealed that there was a significant difference between at least two of the means ($F=4.25$; $df= 2.14$; $p <.01$). Fisher's post-hoc analysis showed that the mean score for children in the high decile band was significantly higher than the middle and the low decile band. There was no difference between the means score for the middle decile band and the low decile band.

Table 4.26 ***Mean and Standard Deviation of Scores for 'Out-of-context' Task by Decile***

Decile	N	Mean	Std. Dev.	F
High (8-10)	6	10.17	5.91	4.25
Medium (4-7)	5	3.60	0.89	$p < .01$
Low (1-3)	6	4.30	3.67	

Because the medium and low decile schools were not significantly different I suggest that the reason the high decile school was different was because it had specialist facilities and there was a clear focus on technology in the school. Also children from high decile and in this case a private school may be more likely to have had a greater range of experiences to call on when dealing with an 'out-of-context' situation.

'In-context' Task

When I compared results between decile bands for the 'in-context' task the above difference disappeared. There was no significant difference in the mean scores of children between decile bands for the 'in-context' task (see Table 4.27). This suggested that the difference that occurred before the unit was taught disappeared with the teaching of the unit. This also added strength to the claim that the same programme was consistently delivered across all schools.

Table 4.27 *Mean and standard deviation of scores for 'in-context' task by decile*

Decile	N	Mean	Std. Dev.	F-value
High (8-10)	12	14.67	3.27	1.85
Medium (4-7)	12	15.20	2.49	n.s.
Low (1-3)	12	15.00	3.03	

Analysis across Aspects and Decile Bands

I also analysed the results between decile bands in each aspect to determine whether there was in fact significant difference in any one aspect. This may have offered an explanation as to why the significant difference evident in the 'out-of-context' task disappeared for the 'in-context' task.

Quality of the Solution

Seventy five percent of children in the high decile band, 100% of children in the middle decile band and 92% in the low decile band scored in the 'clearly workable' and 'probably workable' category. Seventeen percent of children in the high decile band and 8 % of children in the low decile band and no children from the middle decile band scored in the 'possibly workable' category. No children in the lower two decile bands and 8% of children in the high decile band scored in the 'unworkable' category. This showed that there was not a relationship between success and decile band in this aspect. The highest decile band was the only band to score in the least desirable category (see Table 4.28).

Table 4.28 *Percentage of children by decile who scored in each category of Aspect One Quality of the Solution*

Decile	Clearly Workable	*Probably workable*	Possibly Workable	No Solution/ unworkable solution
High (8-10)	58	17	17	8
Medium (4-7)	67	33	0	0
Low (1-3)	75	17	8	0

Quality of the Plan/ Picture Diagram

Children in the middle decile band performed best in this aspect with 91% in the highest category 'quite detailed' and 17% in the second category 'rudimentary'. Children in the high decile band performed next best with 58% in the 'quite detailed' categories and 42% in 'rudimentary'. Half of children in the low decile band scored in each of the top two categories. No children in any decile band presented no plan or diagram (see Table 4.29). Again there seems to be no relationship to decile band and performance in this aspect.

Table 4.29 *Percentage of children by decile who scored in each category of Aspect Two Quality of the Plan/ Picture Diagram*

Decile	Quite detailed	Rudimentary	No plan/diagram/ picture
High (8-10)	58	42	0
Medium (4-7)	91	17	0
Low (1-3)	50	50	0

Quality of the Explanation

In this aspect there was no difference between decile bands. All children scored 75% in the highest categories and 25% in the middle categories. No children in any decile band presented no explanation (see Table 4.30).

Table 4.30 ***Percentage of children by decile who scored in each category of Aspect Three Quality of the Explanation***

Decile	Quite detailed	Rudimentary	No Explanation
High (8-10)	75	25	0
Medium (4-7)	75	25	0
Low (1-3)	75	25	0

Nature of Solution

All children in the middle decile band and 91% of children in the low decile band included a method of 'holding the potato still' in their plan. 75% of high decile children did this. 98% of children in the low decile band, 75% of children in the middle decile band and 58% of children in the high decide band included a 'method of holding the aid still'. Few (8%) or no children in all decile bands mentioned keeping the blade still, getting someone else to help, designed a machine or presented an unworkable solution (see table 4.31).

Table 4.31 *Percentage of children by decile who scored in each category of Aspect Four Nature of solution*

Categories	Holding potato still	Holding aid still	Holding peeler still	Machine	Somebody else to help by holding	No Workable Solution
High 8-10	75	58	0	0	0	8
Medium 4-7	100	75	8	8	0	0
Low 1-3	91	98	0	0	0	0

As with all the other aspects there was no relationship here between performance and decile. No particular patterns emerged within aspects across decile bands. Performance and decile band were unrelated for this 'in-context' task.

Teacher Competency and Knowledge

To make explicit the links between improved teacher knowledge and improved child achievement comments were included to illustrate the impact the professional development had on the teachers involved.

The results have shown that the instructional package offered to the children had a big positive impact on their achievement levels for this task. One of the key factors of the instructional package undertaken by the teachers was the improved teacher knowledge in the identified technological process. Using a Knowledge Identification Sheet (KId Sheet, Appendix 11) the teachers and I discussed and identified key aspects of knowledge in each of the four domains (Moreland, Jones & Chambers 2001). This was done at both specific and generic levels (specific to this unit and generic to all technological areas). Once identified the knowledge in each domain was incorporated into the unit plan as a part of the learning experiences undertaken by the children. Links between the knowledge domains and the learning experiences are discussed further in Chapter Five.

Links to Teacher Professional Development

It is clear from the above results that children were better able to perform the task after they had experienced related learning prior to completing the task. The teachers commented on their increased understanding and confidence in teaching technology education in the future after the professional development day. This is reflected in their comments during Interviews One and Two.

> I enjoyed the day we had and we actually got to make it (the aid)….. I was blown away by the depth of planning…. and I went home thinking 'my goodness'. In reality I could follow in the classroom the KId sheet. The planning was very very detailed….. It is very thorough. (Teacher F, Interview One, 18 April 2002).

> After the session I was just buzzing. I loved it. It was great to be able to get to do it. Once we get into the unit and see how they are going to react to it I will feel fine but I suppose I am a bit tentative of the ones that are (behaviour problems) (Teacher E, Interview One, 17 April 2002).

> (The unit) so well planned I think. No worries at all. I sort of been through it. So well set out in detail. I think it (the unit plan) is

> exceptional. Definitely the planning together. We have quite enjoyed it. Just brought a lot of aspects together which was helpful- the planning and we discussed it in depth. So helpful (Teacher D, Interview One, 16 April 2002).

> I feel a bit more confident now to go out and do some technology (Teacher F, Interview Two, 14 June 2002).

> Full inspired. Like from Day One really. (Teacher A, Interview Two, 22 May 2002).

> It (technology) is achievable....before I would have got them to draw the design. Where as now I feel confident enough to get them to actually make (Teacher E, Interview Two, 17 June 2002).

> It has been really good for me. Basically starting with the planning and the setting out and the structure. Because of the plan we used it is a lot easier to follow than the things I have done in the past. (Teacher C, Interview Two, 13 June 2002).

Conclusion

Overall the results show a very clear difference between the children's performance in the 'out-of-context' task and the 'in-context' task. Results from the 'in-context' task are significantly better than that of the 'out-of-context' task both by aspect and overall. The children were better able to offer a solution to the problem identified in the task- allowing a one-handed person to peel a potato. Their plans and explanations were more detailed. Their solutions were more likely to incorporate key features such as holding the potato still and stabilising the aid so that the potato could be peeled successfully. Completing the 'out-of-context' task did not affect the results of the 'in-context' task and therefore the children were not sensitised by the 'out-of-context' task. Overall difference in decile band had no effect on the children's achievement in the 'in-context' task. And finally teacher knowledge was enhanced by the professional development offered to them, which I believe was one of the reasons for the improved achievement levels of the children.

Chapter Five: Discussion

Introduction

The focus for discussion in this chapter is the relationship between the results presented in the previous chapter and my research questions. The difference in achievement levels between the assessment task taken 'out-of-context' and 'in-context' reflected the learning that occurred for the students during their technological practice. Factors influencing the quality of students' learning are improved teacher knowledge and the learning experiences undertaken by the children. In this chapter I offer a model of student technological practice which indicates how practice for students is framed within a number of different factors and altered by intervention from teachers. The chapter concludes with identification and discussion of recommendations for technology education in New Zealand, NEMP and student technological practice.

Key Question

What is the relationship between the context of an assessment task and Year 4 children's ability to demonstrate what they know and can do in technology education?

Questions

1. Compare and contrast the results of the same NEMP task administered using the same guidelines in two different contexts: one as a 'out-of-context' previously unsighted task and one as a part of authentic technological practice within an instruction unit.
2. How does technological practice allow children to demonstrate their ability to design solutions to meet identified needs in technology education?
3. How does a technology education unit based on authentic practice (including conceptual, procedural and societal knowledge) improve child performance?

1. Compare and contrast the results of the same NEMP task administered using the same guidelines in two different contexts: one as an 'out-of-context' previously unsighted task and one as a part of authentic technological practice.

The unit of work and the 'in-context' task the children were engaged in was authentic technological practice as it clearly reflects the technological practice of the Gawith (2000) and Pacey (1985) models discussed in Chapter Two. All three aspects in Pacey's model were encountered by the children. In the cultural aspect they were exposed to the values and beliefs of the amputee. The video helped the children understand that the aid they were making could impact positively on others' lives. The organisation aspects included an understanding of the consumers' needs again from the video and pictures of existing aids and the technical aspect included the physical management and manipulation of resources, equipment and tools to make the aids. The children were clearly involved in purposeful action as stated by Gawith. They gathered information through the planned learning experiences, and selected resources before proceeding with making the aid which involved a number of techniques and skills.

The theoretical constructs mentioned in Chapter Two highlight the need for 'in-context' learning. The theories that I believe are most strongly supported by this study are the theories of Situated Cognition and Cognitive Apprenticeship (Hennessy, 1993). These children were embedded in authentic technological practice and were fully aware of the need of the aid and the impact it could have on the life of a one-handed person. The children were given authentic opportunities to measure, speak, experiment with materials and to draw and plan.

It can be seen from the overall total score from each school that the results of the 'in-context' task were higher than the 'out-of-context' task. Before the answer to this question could be fully discussed I needed to determine whether the children were sensitised by the 'out-of-context' task. Sensitisation was an issue discussed in the previous chapter.

It can be seen from the results in Chapter Four that by comparing the 'in-context' task results in Group One with Group Two schools that there was on difference between them. This meant that the children were not sensitized by the 'out-of-context' task and therefore all schools were treated as one group. This indicated that the children did not discuss the 'out-of-context' task with their classmates after they had completed it with me. The Group One schools were not advantaged in the 'in-context' task by being exposed to the task before the unit was taught.

Also important to this research was whether the programmes were delivered consistently to all six classrooms. Cooperative unit planning ensured that all teachers were involved in the selection and writing of the learning experiences undertaken by the children and therefore agreed with their inclusion. I had a large input of time during the teaching of the unit in all schools. This input ensured that the same programme was delivered to all schools. However, I was unable to control what the teachers did when I was not present. Interview One determined that all teachers fully intended to follow the planning carefully and Interview Two determined that they did, in fact, follow the planning. To further prove that the programme was delivered consistently to all schools I compared all 'in-context' scores by school. The results showed that there was no statistical difference between the schools and therefore all classroom programmes could be seen to be equivalent.

To fully investigate this comparison separate aspects were considered.

Quality of the Idea/ Solution

The first aspect looked at the quality of the idea. NEMP identified four categories of which 'clearly workable' was the most desirable and 'probably workable' the next most desirable. These two categories implied that the solution planned by the children had a very high chance of succeeding. The next two categories 'possibly workable' or 'unworkable' were the least desirable. Only 24% of children in the 'out-of-context' task scored in the top two categories, while 89% scored in the top two categories in the 'in-context' task. There was obviously a big shift here between the 'out-of-context' task and the 'in-context' task. Almost half of the children in the 'out-of-context' task presented a solution that was unworkable. These children clearly struggled with this task in an 'out-of-context' previously unsighted situation.

During the teaching in the unit the children were exposed to a number of different aids that one-handed people used. Vaughan, the one-handed interviewee shared a number of the aids he used to help complete everyday task. Another activity the children were required to do was to look at pictures of a number of aids. Enable New Zealand supplied these pictures. The catalogue provided by Enable New Zealand allowed disabled people to order these aids, not commonly on the market. I selected the pictures to cover a range of household tasks: stirring a saucepan, doing up a zipper, opening a can, eating food from a plate, cutting fruit and vegetables for example. None of the aids the children saw in the investigation into existing aids were for peeling vegetables. The realisation that there are people out in the real world who actually require aids to help them do everyday tasks and that aids were actually manufactured for these people had a big impact of the solutions offered by the children.

> Their general attitude to the unit- we have unit *[special education unit]* in the school for children with special needs and just their attitude to those children have changed........... I have heard them say 'Oh they (disabled people) just do it differently, slightly more challenging but they can do it' and things like that. (Interview Two, Teacher C, 13 June 2002).

The task became authentic at the children's level as they realised that anyone could become one-handed at any time and that people do actually design aids to help one-handed people. By making use of a deliberate social context (Hennessy, 1993) the activity became more relevant and meaningful. This also added strength to the need to include the social context within technological development. Burns (1997) discussed the importance of recognising the conflict between the competing interests of the commercially driven and the development of desirable technological outcome for people. There needs to be recognition that technology is socially constructed and has huge consequences for the quality of life. Hennessy and Murphy (1999) discuss the need for frameworks of knowledge that are built up, constructed and tested by giving children authentic problems. It is clear that technology takes form from the values of the society in which it develops. Children need to be encouraged to think about and be aware of people who are different to them, why they are different and how this influences their (them and others') lives (Hennessy, 1993). Embedding this practice as a part of normal technological practice and recognising this within the assessment framework will hopefully encourage an empathetic generation of children.

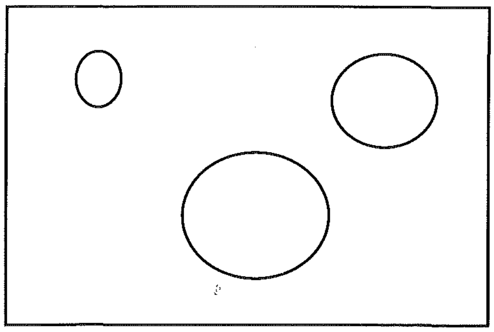
Quality of the Plan

All the children who completed the 'out-of-context' task produced rudimentary plans, while two thirds of children in the 'in-context' group provided detailed plans. This could be explained in several ways. For a plan to be detailed it required mention about measurements or the materials used in the design. One of the unit activities was an investigation into a range of materials. The children scrubbed, folded, slid across a bench and tore selected materials to test them for desirability. Each group concluded the activity by listing the materials that may have been suitable for their design. Children also sketched three initial design ideas and discussed these with their peers or an adult so that by the time they undertook the planning as a part of the 'in-context' task they had sketched and verbalised ideas and selected a final idea based on the feedback they received. Procedural knowledge (McCormick, 1997) could explain the increased achievement. When the children completed their plans they were aware of a procedure for the development of the aid. The plans the children drew were a part of a process. The children were aware that their plans were to help them move through the design process of developing an aid. McCormick (1993) identified that procedural knowledge is a major component in successful learning in technology.

Assessment of planning allowed teachers insight into the way that children had used information from prior learning and planned learning experiences. Kimbell (1997) discusses the need for assessment of process of design rather than just the product. Assessing planning allows insight into the processes undertaken by the children. It was therefore very important that teachers allowed children the opportunity to discuss their plans and justify their decisions. Often new and complex thinking and understanding are not always obvious from just looking at the plan or children's work. By allowing the children the opportunity to discuss their work not only helped their development and learning but also gave teachers valuable insight into children's thinking. Discussion points with children also offered the teachers and me an opportunity to alter the children's technological practice. While it was not desirable for the teachers to tell the students what was 'wrong' with their designs careful discussion and questioning has the advantage that it can enhance children's ability to move in a different direction within their technological practice, which may ultimately lead to an improved or more successful solution to the identified problem. Obviously this depends on the teachers having appropriate knowledge and understanding within the identified technological practice.

An example of this was a girl from School E who planned a box-like aid with holes in the top for the potatoes to sit in. Her plan looked something like Figure 5.1. The different sized holes were for different sized potatoes.

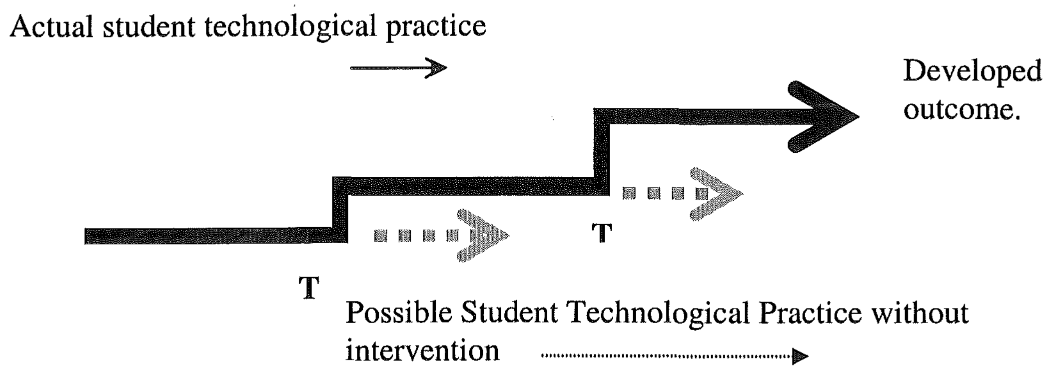
Figure 5.1 ***A diagrammatic representation of an aid planned by a girl in School E***



She planned two-dimensionally and also built the mock up in this manner. She brought me her mock-up made from cardboard. The mock-up consisted of two rectangular pieces of card, one with holes similar to the diagram. The two pieces of card were stuck one on top of each other. I questioned her about her design and asked her if the potatoes would stay on the holes while they were being peeled. She realised that they might not. I asked her how she could improve her design. She thought it would be better if the bottom and the top were apart. At this stage she realised that sides would need to be added so that the potatoes could slip into the hole to be held securely. With my knowledge of aids and scientific principles, careful questioning and her experience from the learning activities, this girl's technological practice was enhanced and increased her chance of developing a successful outcome.

This case illustrates how student technological practice is altered by teacher intervention through careful questioning and conferencing with the child. The LITE research (Moreland et al. 2001) identified the need for teachers to have not only content knowledge but also knowledge about how children learn in technology. The altered practice can be seen in Figure 5.2. It is important to note that practice is not changed completely and that the final decision making is the students'.

Figure 5.2 ***The Effect of Teacher Intervention on Student Technological Practice***



T=Teacher Intervention

Quality of the Explanation

Approximately three-quarters of all children completed a detailed explanation in the 'in-context' task. Only 18% of children in the 'out-of-context' group presented a detailed explanation. The detailed explanation needed to expand the information given in the plan and it required discussion about how the design would achieve the required action. I believe that by having completed the learning experiences from the unit plan the children completed the 'in-context' task with more confidence. Identification of the criteria needed for a successful aid, which was one of the learning tasks experienced by the children and a normal part of authentic technological practice, were clearly reflected in the children's explanations in the 'in-context' task (spelling edited by the writer where necessary).

> It holds the potato by wedging it in (Billy, School C)
>
> It makes it easier because the potato doesn't move and the board (doesn't move). (Oshiarne, School E)
>
> The potato is hold still. You will not need to bend down to peel the potato. (Matthew, School D)
>
> The plastic matting is to make it stick to the table and the other plastic matting to make the potato stay still. (Cara, School D)
>
> It makes it easier to peel the potato because the potato stays still in the hole and the suction pad keeps the wood still. The Vivac keeps the aid clean while not used. The aid can be cleaned with water. You can put it away. (Laura, School A)

> You can stick the potato on the nails and the plastic matting because it will stop the wood from moving. (Jordon, School F)
>
> You put the potato on the nails and it makes it stable. (Willem, School B)

It was clear from the given explanations that the children were aware of the need to secure the potato and stabilise the actual aid. Vaughan mentioned these things in the video and many of the aids in the pictures the children saw also had these features.

Figure 3.10 shows a grater with suction feet to secure it to the working surface. Many children took this feature and modified it for their designs. I was impressed at the level of knowledge transfer from one activity to the next. The children used the conceptual knowledge they had gained in their activities. This was encouraged during the materials investigation because the children were asked to discuss in their work group which materials they considered suitable for an aid. The children were not directed to actually use the identified materials for their aid but nearly all did. Other links from the activities to their actual designs were less explicit but clearly transferred. "What I found the girls actually got out of it was one of understanding that inventions are like building upon existing ideas, like the aids out there" (Teacher A, Interview Two, 22 May 2002).

An explanation for poor performance in this section could have been the children's ability to write. As the children were not selected on ability I did not think this alone could account for the clear differences between the 'out-of-context' group and the 'in-context' group. All children were instructed to attempt the task. Explanations were not assessed on accuracy, grammar or neatness.

The Nature of the Solution

Desirable categories in this aspect included mentioning ways of holding the potato still and ways of holding the actual aid still so that pressure could be applied if necessary. Another idea ranked third in desirability was 'a way of holding the peeler still'. This was below the other two categories because the girl in the picture was peeling the potato using an existing peeler. An aid would be longer lasting and more versatile without a blade attached for peeling.

Designing a machine, which may not have been possible for the children to actually construct especially within the given time frame, was a less desirable category than the three mentioned above. Getting another person to help or designing an 'unworkable solution' were the least desirable categories for this aspect. In this aspect unlike any of the others the children were able to score in more than one category. In the 'out-of-context' group only one third of the children identified a way of holding the potato and 18% identified stabilising the aid. Nearly all the children in the 'in-context' group identified a way of holding the potato and over two thirds identified a way of stabilising the aid. Once again this could be explained by the 'in-context' exposure to existing aids and a range of investigated materials. Only one child in the 'in-context' group offered an unworkable solution compared to almost half in the 'out-of-context' group. Clearly the learning experiences modelled in authentic technological practice that took place between the 'out-of-context' task and the 'in-context' task allowed the children to improve achievement in planning technological solutions to meet identified needs. Constructivist theory described how knowledge frameworks were built up, tested and altered as new knowledge came to light. This point is important because as Hennessy and Murphy (1999) and Hill and Smith (1998) argue children were motivated when they could see the relevance of and/ or need for their work. The clear differences between the nature of the solution in the 'out-of-context' task and the 'in-context' task indicate that these children had built the frameworks they had constructed during their authentic practice. The nature of the planned learning experiences had provided an opportunity for them to see the relevance of their practice to an authentic problem experienced by some people.

An example of this is evident when plans of both tasks are examined. In the 'out-of-context' task a number of children thought that the girl in the photo (Amy) could simply remove the sling or fix her arm to peel the potato. This option was not suggested in any of the 'in-context' plans. I suggest that the reasons for this were viewing the video of Vaughan who clearly couldn't fix his amputated arm and discussion about who might have the use of one arm. The children were encouraged to realise that people have the use of only one arm for many reasons and that a number of these conditions were not fixable. I believe the task became more authentic to the children with the inclusion of these two activities.

2. How does technological practice allow children to demonstrate their ability to design solutions to meet identified needs in technology education?

NEMP 2000 identified that children in high decile schools performed better than those in low decile schools (Crooks & Flockton, 2001). I believe children in higher decile schools were more likely to have had greater exposure to a wider range of experiences, materials and equipment perhaps due of the socio-economic and professional status of their parents.

The results for School A in the 'out-of-context' confirm this. School A performed significantly higher than the other two schools in the 'out-of-context' task. School A has a purpose built technology room. The children were familiar with the room and the equipment we later used for the practical aspects of the unit. They had the two highest individual scores of 15 and 19 in the 'out-of-context' test. Average totals for the other two schools were well below that of School A. The two lowest individual scores came from School E in the lowest decile band. These children were less likely to have had a range of activities and experiences that may have informed this task. I acknowledge it was difficult here to make generalisations because only one class was involved in each decile band, however, it was interesting to note the differences.

In the 'in-context' task I found very little difference between the low and the high decile schools. Interestingly, in the 'in-context' task one of the high decile schools, School B was the poorest performer with the lowest average score overall. While I was at School B the teacher commented to me that the children very rarely did much hands on activity of this nature. The children were very excited about moving down to the specialist science room to do the practical activity. Unlike the other high decile school in the project, School B did not have a technology room and technology does not appear to be a focus for the school. Another explanation for the poorer performance for School B could have been that they were all boys completing a written assessed task. Teacher B comments about the need to reinforce the language with the boys.

> Taking the children through their paces and demonstrating parts on the way. Introducing the language to them. It has meant that they have been able to take so much on board as well as get

> more out of the whole process (Teacher B, Interview Two, 13 June 2002).

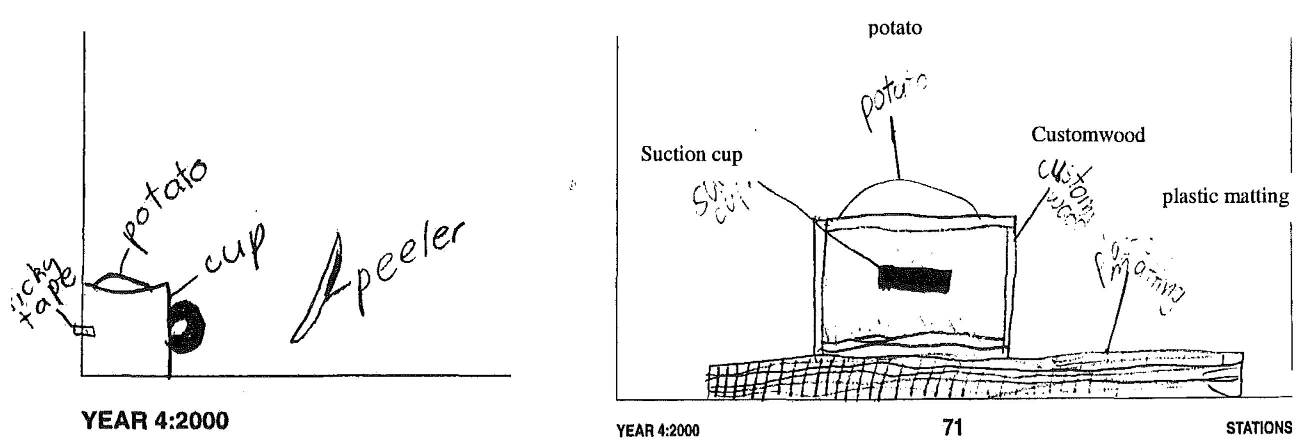
I suggest that the programme undertaken by the children in the form of the taught unit removed differences between the schools. All children experienced exactly the same learning experiences and in a similar, if not exactly the same, order. Because I provided and set up the activities I ensured that all children participated in the same technological learning experiences. However, there may be another explanation for this in relation to the low decile schools. During Interview Two, teachers in both School E and School F told me that they spent considerable time between my sessions in the class reinforcing the learning that had occurred. For these teachers this was a part of normal classroom practice. Teacher E showed the video to the children twice and both added extra times for discussion and recapping the learning that occurred during my time in the classroom.

> I model to them. They just do not have the experiences and perhaps the ability it do it....They do need more direction definitely....it highlighted for me a lot of them don't actually do anything like that (peeling) at home (Teacher F, Interview Two, June 14).
>
> They hadn't experienced a lot of other things.... We did a lot of discussion, a lot of how Amy (girl mentioned in the brief) would have felt. We actually watched the video twice, which was really essential. Because the first time they hadn't got rid of the extra stuff that we had to talk about. I used a lot of discussion. We talked about it through the day. But I did feel that I had to put a lot more into each. We would have a lesson together then I would have to reinforce it. They just don't pick it up quickly as maybe other children might (Teacher E, Interview Two, June 17).

It is important to note however that the teachers did not add any new or extra learning. It is difficult to know whether this actually impacted on the results of this project but it does offer an explanation as to why the lower decile schools' performance was similar to the other two decile bands.

Another way of illustrating the difference authentic technological practice made was by comparing high scoring plans in the 'out-of-context' task with high scoring plans in the 'in-context' task. The high scoring plans in the 'out-of-context'' task must have met the categories determined by NEMP, just as those in the 'in-context' task did. By comparing the two we are able to see a shift in thinking related to the practicality of the designs. Brittany (School A) scored three for the 'Quality of the Solution' aspect in both the 'out-of-context' task (Figures 4.12 and 5.3-left) and the 'in-context' task (Figure 5.3- right). By comparing the two I was able to see the influence her technological practice had on her ability to design a suitable practical solution to the identified problem.

Figure 5.3 ***Brittany's 'Out-of-context' and 'In-context' Tasks.***



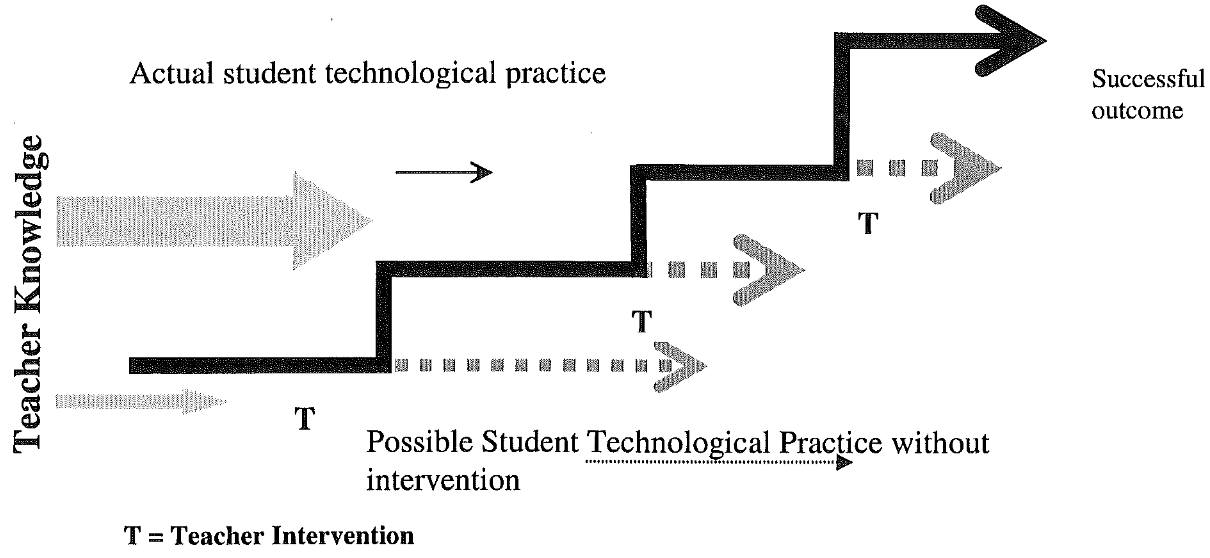
Her 'out-of-context' plan showed a cup stuck to the wall. The high score in this aspect is attributed to the fact that the plan mentioned holding the potato and the aid still- worth 10 out of the 15 points she scored. Brittany was the top scorer in the 'out-of-context' task. It is clear her solution shows insight in to the requirements needed to peel a potato one-handed but she appeared not to have had the knowledge or experience to plan a more practical solution e.g. suction cups rather than sticking tape to secure the aid to the wall. There was a lack of authentic learning in the field of practice at the 'out-of-context' stage. Brittany also completed the 'in-context' task (Figure 5.3- right). For this she scored 17. There were a number of features of Brittany's design that were common to both her plans, however, her design for the 'in-context' task was much more practical than that of the 'out-of-context' task and it was a design that was specific to the intended purpose. The common features in Brittany's designs were as follows; both had the potato sitting within a structure- in a cup in the 'out-of-context' task and in a wooden box for the 'in-context' task and both mentioned securing the aid to the wall, in the 'out-of context' task tape was used and in the 'in-context' task a suction cup is used.

Brittany's 'in-context' task was much more practical and a more specific solution than that offered in the 'out-of-context' task. In Figure 5.3 the plan on the right ('in-context' task) would not damage the wall. It was designed specifically for the purpose and clearly made use of the knowledge gained in the learning experiences. Vaughan mentioned the use of suction cups and plastic matting in the video. Customwood was one of the materials found to be durable and washable in the materials investigation. Influence from these was clearly evident in Brittany's 'in-context' design.

Teachers need to be aware that the learning experiences offered to the children in Strand A and C impacted on the children's technological outcome. Teacher knowledge and understanding of authentic practice in the field within which a unit is situated is a necessity so those teachers can plan for a range of relevant learning experiences. The planned learning experiences need to enable students to follow authentic practice as much as is possible so that they can gain enough relevant information to be able to design a successful technological outcome. Feedback given by the students by the teachers is only as good as the knowledge and understanding they have on the topic. Feedback given to the students by the teachers is only as good as the knowledge and understanding the teachers have on the topic and the processes involved. For example if students are required to produce a model illustrating improved traffic flow and student safety at their school gates teachers need to be able to teach the students correct modelling techniques for the development of such things as roads, trees, buildings, fences and other structures.

Figure 5.4 illustrates how teacher knowledge can impact student technological practice. It differs from Figure 5.2 as it illustrates that increased and improved teacher knowledge will improve the quality and timing of the teacher intervention and therefore increasing the likelihood of the students producing successful technological outcomes.

Figure 5.4 ***The Impact of Teacher Knowledge on the Quality and Nature of Intervention on Student Technological Practice***



3. How does a technology education unit based on authentic practice (including conceptual, procedural and societal knowledge) improve child performance?

When teachers have a deeper understanding to the knowledge necessary for technological practice they are better equipped to direct students along a pathway to developing a successful technological outcome (Moreland et al., 2001). The teachers on this project were introduced to the four knowledge domains identified as necessary to technological practice. To understand the connections between the knowledge domains and the authentic technological learning experiences undertaken by the children in this study, links were made between the identified knowledge to the learning experiences.

Each learning experience undertaken by the children was linked to at least one of the knowledge domains. Knowledge identified for this unit was recorded on the Knowledge Identification (KId.) sheet (Appendix Eleven) In Tables 5.5, 5.6 and 5.7 the knowledge identified as necessary to this technological practice is linked to the learning experiences undertaken by the children. All four knowledge domains are fully covered. Some learning experiences met more than one knowledge domain. For example, peeling the carrots allowed the children to understand the process of peeling (procedural) and the technical skills of doing so (technical). Some identified knowledge was covered in more than one learning experience. For example 'how people feel about being disabled- the challenges and the frustrations were touched on in the learning experience when the children were playing one-handed and through the video listening to Vaughan talk about being one-handed. The learning experiences in Tables 5.5-5.7 are divided into the three strands identified in *Technology in the New Zealand Curriculum*- Knowledge and Understanding (Strand A), Technology and Society (Strand C) and Technological Capability (Strand B) (Ministry of Education, 1995). The reason Strand C is listed before Strand B is because I believe that Strands A and C build students' knowledge and understanding about technologies and the people involved. In most cases both need to be taught before or possibly while the students develop solutions to meet identified needs in the capability strand, Strand B. Strand C may not have the same impact on students' learning if it occurs after their own practice.

Table 5.5 ***The Relationship between the Knowledge Domains and the Learning Experiences Undertaken by the Children in Strand A, Knowledge and Understanding***

Learning Experience **The children will........**	**Knowledge Domains**	**Actual knowledge**
experience peeling first carrots and then potatoes to ensure they are familiar with the task required of Amy	Procedural	peel a carrot and a potato using a standard peeler and experience the action and movement necessary. Identify action undertaken by both hands
	Technical	use a potato peeler to first peel a carrot (straight action) and then a potato safely use a potato peeler.
investigate aids by studying a series of pictures that are available for those who have the use of only one arm	Procedural	examine a wide range of aids and determine needs / categories for design and construction
	Conceptual	a hand aid usually increases stability to an object spikes and /or suction are useful for stability
investigate suitable materials for aids. They will need to be scrubbed and washed, lightweight and aesthetically pleasing to individuals	Procedural	examine and testing of a range of suitable materials for the aid
	Conceptual	suitable materials for an aid may be plastic (styrene, Vivac, coreflute), Customwood, metal, rubber

Table 5.6 *The Relationship between the Knowledge Domains and the Learning Experiences Undertaken by the Children in* ***Strand C, Technology and Society***

Learning Experience **The children will……..**	**Knowledge Domains**	**Actual knowledge**
view the video of Vaughan Hill an amputee who lost his arm below the elbow in a shark attack. Vaughan discusses his disability and how he feels about doing things for himself and how he adjusted to life with only one arm. He also talks about the things he uses to help him.	Conceptual Societal	an aid for a one handed person increases stability of an object aids need to be attached to a solid base or very stable for action (cutting, peeling, scraping, spreading) to occur spikes and /or suction are useful for stability of the objects suction, increased friction and a screwed mechanism are methods used for securing the aids how people feel about being disabled- the challenges and frustrations how people adjust to a new disability reducing the time taken to do a task can improve working conditions
experience a lunch time with an arm under their jersey and discuss their frustrations and challenges at being one-handed	Societal	how people feel about being disabled- the challenges and the frustrations
investigation into who, and why people have the use of one arm (arthritis, amputees, broken or dislocated, birth conditions)	Societal	different people find different features more important reducing the time taken to do a task can improve working conditions how people adjust to a new disability

Table 5.7 *The Relationship between the Knowledge Domains and the Learning Experiences Undertaken by the Children in* ***Strand B, Technological Capability.***

Learning Experience The children will........	Knowledge Domains	Actual knowledge
identify criteria needed for Amy's aid	Conceptual	suitable criteria may be: increases stability of potato, cleanable and scrubable, easy to use, can peel potato on own, can peel whole potato, only one hand needed for the whole operation function is more important than aesthetics in designing an aid anthropometrics is the study of the human form that informs the use of ergonomics in design (optional as extension)
sketch two or three initial ideas and select one	Technical	produce a concept drawing with notes
justify selection to teacher or a group of peers	Conceptual	Understanding the following terminology and use it appropriately: ergonomics, functional, user-friendly, model, reliable.
take selected idea and develop fully into an annotated plan of aid, include size, materials used and explanation as to how it makes it easier to peel a potato	Procedural Technical	make a 3D presentation drawing make annotated detail drawings of the significant features to be included in their design make annotated concept drawings of their design detail drawings – 2D and 3D as required produce a presentation drawing in 2D or 3D with notes.
make a mock up of design using cardboard, make modifications to initial designs if necessary compared to the aid produced	Procedural Conceptual Technical	ensure all materials and equipment suitable for constructing an aid to peel a potato peeler are available there is a difference between at plan on paper and a 3D model conversion from 2D to 3D safely use a craft knife safely use a hot glue gun score a card (make a mock-up if time allows)

Table 5.7 (continued) *The Relationship between the Knowledge Domains and the Learning Experiences Undertaken by the Children in* ***Strand B, Technological Capability.***

Learning Experience **The children will……..**	**Knowledge Domains**	**Actual knowledge**
make to final model of the aid and test by peeling a potato	Procedural	the relationship between the plan, the aid and the potato construct model of their design
	Technical	use the following processes, tools and / or materials as appropriate for producing a realistic model safely adhering surfaces (stapler, gluing, tabs) assembling mixed materials (metal, wood, plastic) using a hand saw and /or hammer using a hand electric drill
evaluate designs and discuss final product and the differences	Procedural	evaluate according to negotiated criteria and principles such as user-friendliness, modification, adaptation, ergonomics, reliability, fitness for purpose
	Technical	safely use a potato peeler.

Jones and Moreland (2001) found that working across all four domains enhanced children's learning. The children involved in this project clearly experienced all four knowledge domains. The children's achievement in the planning task, situated in Strand B was enhanced by the technological practice that preceded it. This involved learning in all four domains both in Strands A and C and a little in Strand B. In all aspects assessed the children from the 'in-context' task performed considerably better than those doing the 'out-of-context' task.

As mentioned earlier, McCormick (1997) identified procedural knowledge as a major component to successful learning in technology. Knowing the procedure of peeling potatoes and carrots was crucial to the children's understanding of the key features of an aid. While peeling they needed to think about what the hand without the peeler was doing. This helped them to identify what an aid needed to do. They needed to be able to examine a series of pictures of aids for one-handed people (existing technologies in the field) and identify key features. Once again this process was fundamental to building up an understanding of aids for one-handed people.

Conceptual knowledge was also vital to this practice (McCormick, 1997). The children needed to know that aids increase the stability of the object and that the aids themselves are not as effective if they slide around the bench. The learning experiences allowed them to discover the spikes, wedging, suction, and increased friction which are required to ensure an increased stability. The technological principles of modification, durability and fitness for purpose were also touched on by the learning experiences by the children.

Knowing how to do something and actually being able to do it are not the same thing. The hands on nature of this unit allowed the children to develop the necessary skills. I was very surprised that about half the children in every class (I asked for a show of hands each time) had never peeled a potato. Most children wanted to rest the potato on the table and held the peeler very tightly, over the actual blade so that it couldn't swivel. The children had to be taught to hold the potato in one hand and to hold the handle of the peeler in the other. Many children pushed the peeler away rather than pulling it towards them while they peeled the potato. Having learnt the skill the children had a better understanding of the role of the aid would have to play for a one-handed person.

Societal knowledge had a big impact on these children. Viewing the video allowed them to see a man who was like us all, he loved fishing and scuba diving and had a new baby, whose life was shattered by a freak encounter with a shark (it could have been a car, machine or a disease just as easily). The children's empathy with Vaughan amazed me. What the video did was to make this problem authentic. It enabled them to think that this actually happened to Vaughan, it could happen to anyone. We also discussed why people only have the use of one arm. One girl in School E told me she was going to give her aid to her aunty because she (the aunt) had lost her arm to cancer. Hennessy and Murphy, (1999) and Hill and Smith (1998) discuss that an individual's ability to construct representations within frameworks increases knowledge. By giving these children an authentic problem that they were able to relate to and see the relevance of their learning which increased their motivation significantly.

Student Technological Practice

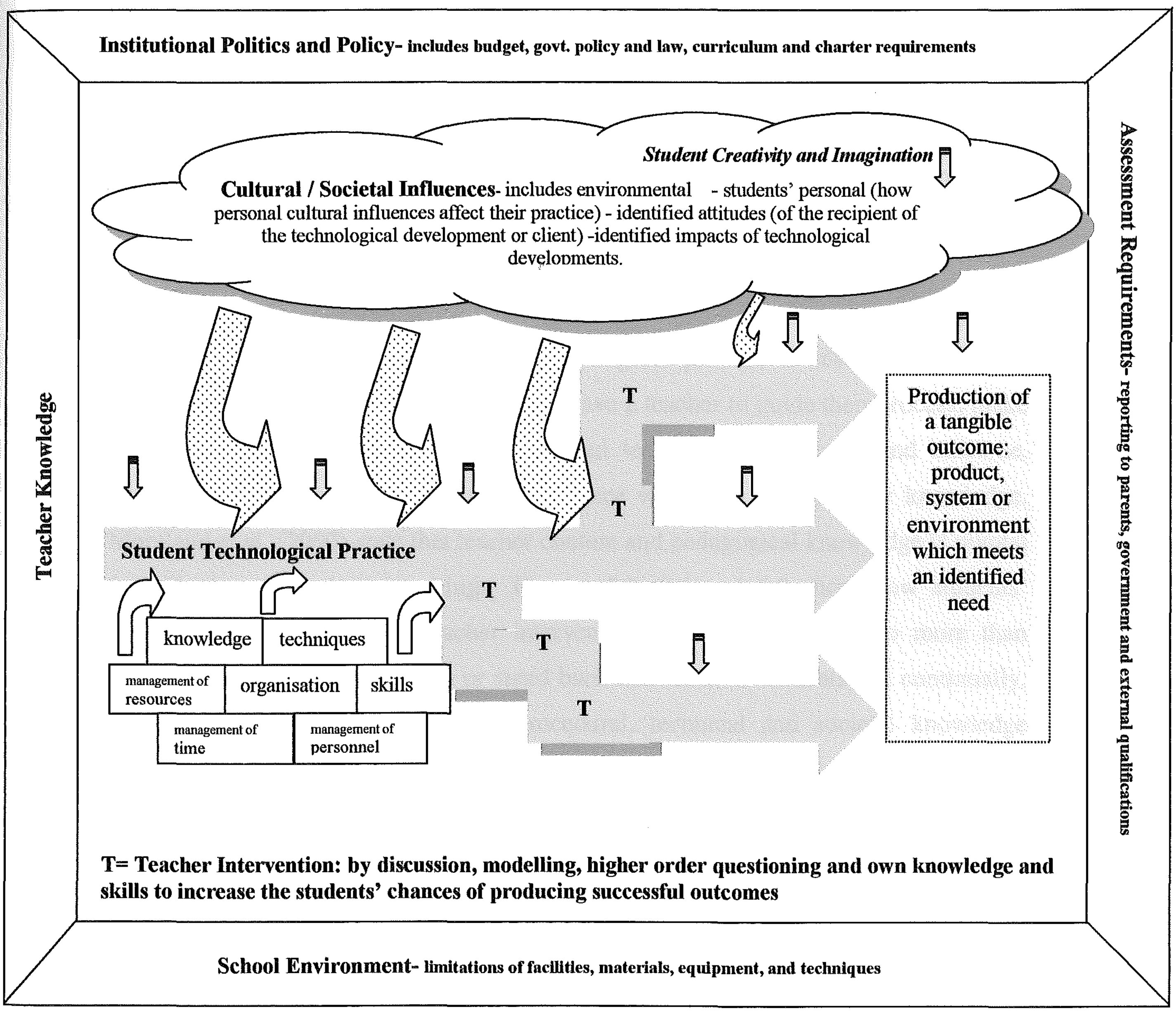
The learning experiences undertaken by the children in this project allowed them to participate in authentic practice as much as was practical. There was one change I would have made to help the children clarify their thinking. In the materials investigation the first question, 'Can the material be bent without damage?' was poor. Some materials were unable to be bent while some could be bent with damage. In both instances a negative answer was required, but with very different outcomes. Better questions would have been: Can the material be bent? If it can be bent was it damaged?

In this report I have discussed the role of authentic technological practice in quality technology education and the part it plays in quality learning for students in technology education. In the theory of enculturation Brown et al. (1989) discusses the influence of culture on practice arguing that the culture of technological practice is an important influence the way a practitioner uses certain tools. Brown et al. also identified a difference between much school activity and authentic activity. Therefore, I strongly argue that it is the responsibility of educators in technology to try and narrow this difference as much as possible.

The conclusion to be drawn is that the nature of authentic practice for students has to look somewhat different from that of 'real' authentic technological practice. Introduced below is a model of student technological practice which incorporates an adaptation the models of authentic technological practice presented by Gawith (2000) and to a lesser degree Pacey (1983) which were discussed in Chapter Two. To maximise student learning technological practice should mirror as much as possible authentic technological practice. It needs to take into account societal needs and impacts. Research and Organisation inform practice which aims at developing a tangible outcome to meet an identified need. The teacher's goal should be to allow student technological practice to be as close to the real thing as possible. In reality however, exact replication is not possible.

I theorise that student technological practice happens within an institutional framework boarded by four factors that impact on nature of authentic practice of students. These factors may affect the degree of authenticity programmes of work in technology education have and the degree and quality of teacher input. These factors are: institutional politics and policy, teacher knowledge, school environment, and assessment requirements (Figure 5.8).

Figure 5.8 ***Model of Student Technological Practice***



The first of these factors is Institution-politics and policy. Any educational institution influences their classroom practice by imposing requirements on the teachers and students. These include such things as curriculum considerations, school charters and policy, timetables and budget constraints. Teachers need to work within the framework of the curriculum. A prescribed number of technological areas need to be covered over a period of one to two year (Ministry of Education 1995). The timetable and meeting requirements in other curriculum areas limit the time teachers and students have for working in technology. Schools also have an established charter and policies that guide teacher behaviour in many aspects. An example is that visits out of school may be limited in some way because of policy. Budget constraints will also have a very significant impact on classroom practice. Technology is a practical curriculum area requiring a large consumable (products and resources that are consumed in the design process) budget. Student technological practice may be restrained because of this.

The second factor affecting student technological practice is teacher knowledge. Unlike real technological practice students have a teacher to guide their process, make suggestions and perhaps alter their intended technological practice and outcome. Obviously the amount and quality of guidance will depend on teacher knowledge. Moreland et al. (2000) state that teacher content and pedagogical knowledge is pivotal for effective technology teaching. Figures 5.2 5.4 and 5.8 show how students' practice can be altered by teacher intervention. Teachers need to do more than facilitate learning in technology or stand back and let their students fail continually. Being aware of sound conceptual, procedural, technical and societal knowledge allows teachers to intervene in student technological practice by suggesting techniques, using open ended or higher level questions to extend and challenge students and ultimately affecting student practice. This should include making the most of the teachable moment. Some skills, techniques and knowledge will be imparted on a need to know basis and could possibly increase the students' likelihood of developing a successful technological outcome. Some students require very little or no intervention, others need significant levels of intervention and may in fact have their practice altered several times during their design process. I acknowledge that failure and knowing that an analysis of failure is an important part of the technological process. Teachers should allow students to make and learn from their mistakes. However, there comes a point when teacher intervention will maximise student learning. Teachers need to use their professional judgment as to when and how much information they share with the students so those students continue to have ownership of their practice and technological outcome. Teachers need to catch the 'teachable moment' to maximise learning. Too much teacher intervention or inappropriate intervention will make any assessment judgments invalid as they would not reflect the practice of the student but of the teacher.

The third factor I considered to influence the degree to which students are able to participate in authentic technological practice was the school environment. The nature of the facilities available in schools limits the processes and therefore affects student technological practice. It is neither practical nor feasible for schools to have very expensive and complex facilities, machines or equipment to allow students to undertake specialised technological practice. Obviously it is not possible for students to exactly mirror the technologist. To begin with they are not experts in the field; they may not have the social, cognitive or physical ability to do so. Hennessy (1993) states that practice for students should reflect authentic practice as much as practicable. As students grow older their social, physical and cognitive skills advance. What is 'practicably close' to practice at Year One may not be so at Year 13. For example it is practical at Year One for children developing painted puzzles to get older people (experts) to paint their designs and to cut them out along lines determined by the children. At Year 13 you would expect students to complete a much larger component if not all of the practice themselves. Injection molding for plastic is another example. It is not realistic to expect schools to have this facility for students. An alternative could be for students to make a model of the final product out of a cheaper material-coreflute (a plastic corrugated cardboard like product) or process-vacuum forming for example. As a part of authentic student practice however, students should be able to recognise which process could be best used to produce the final outcome. For the above reasons schools do not have many of the specialist equipment or facilities needed for more advanced techniques and practice. Facilities in primary schools are very basic with little or no specialist teacher input. At intermediate and secondary levels children have access to a greater range of facilities and equipment and specialist teachers with expertise in a range of technological activities.

The fourth factor identified to frame student technological practice is assessment requirements. This is perhaps more relevant in secondary schools than in primary schools. It has long been known that assessment requirements influence classroom practice. In New Zealand technology education has been included in the new National Certificate in Education Achievement (NCEA) implemented at Level One for the first time in 2002 to students in Year 11 (15-16 Years of age) and at Level Two in 2003 to Students in Year 12 (Level Three is proposed for 2004). Students now have achievement standards to work towards, which they are able to meet with 'credit' or to meet with 'merit' or 'excellence'. It is inevitable that the structure of the qualification will influence the practice of students and what the teachers do in the classroom.

The middle section of the model shows student technological practice in a similar fashion to that of Gawith (Figure 2.2). It acknowledges that social and cultural values and beliefs influence all technological practice. It also suggests that existing knowledge, skills and techniques along with management of resources personnel and time are inputs into technological practice. Also included are student imagination and creativity. Diverse thinking allows students to arrive at ideas that are innovative and exciting. This thinking will influence all aspects of student technological practice and is very important to developing new and exciting solutions. However, unlike Gawith's model, in my model teacher intervention is evident. This research has shown that teacher input clearly influences children's technological practice considerably. It is at these points that students may alter the direction of the practice in light of questioning, facilitation, information and/or direction from their teacher.

I argue that student technological practice takes place within the bounds of the four factors I have identified. Naturally these will influence the degree of authenticity that can be achieved, but it need not completely destroy the modelling of authentic technological practice. Sequence of research and learning can continue to be modelled on authentic practice. Their own culture and beliefs will influence students' practice; they must also consider values and culture of those for whom they are developing a technological outcome. It is also important that they consider likely possible impacts of any development work. Research and planning needs to be thorough and practised if and where applicable. In the end not all students will produce a 'successful outcome'. This in itself is reflective of authentic practice. Very few technologists could claim success after their first try. What is important is that students recognise the learning that has occurred during the process and recognise the next steps. I suggest teachers say to students 'this isn't quite right **yet**' -after all it took Edison thousands of attempts to get a successful light bulb.

"I have not failed. I've just found 10 000 ways that won't work" Thomas Alva Edison (1847- 1931)

Assessment within this framework occurs through the recognition of key stages in student learning and within their technological practice. Key stages will be points during the practice where teachers assess whether the students have significant skill, knowledge and/ or understanding to continue safely with their practice. Assessment can also occur by studying the process and outcome of the students' actual practice. In technology students should not complete separate assessment tasks. Teachers should be able to gain enough information on students' process and the quality of the outcome by assessing aspects of their authentic practice and asking students to justify their technological decision making. This information should in turn be fed back to the students to help them further their own practice.

Limitations of the Study

The major limitation of this study was its modest size. The number of schools involved was limited to six because of my full time work commitments and time constraints. However, the selected range represented both private and state schools, full primary and contributing schools and with full range of soci-economic make-up (Deciles 2a-10). I am confident that the results are fair and would be repeated if another set of schools was selected.

Another limitation was the fact that the study relied on teachers in six classes to present the same unit to their students. The effect of this limitation was decreased by my preparation of the major resources, equal input into all the classrooms and a joint approach to delivery of the unit.

The third limitation was the nature of the task. When selecting the task I was limited to tasks that could be completed individually, were Strand B tasks and were able to be assessed accurately and as objectively as possible. The Help Me Peel task was one of the few that fitted these criteria. Initially I was concerned that the children would not be interested or see the relevance of the task as aids for people with disabilities would not necessarily be within their realm of experience. This limitation was overcome because the learning experiences undertaken by the children enabled them to see an authentic need for an aid such as this. The videoed interview and pictures of existing aids were largely responsible for this.

Constraints of the Study

As with all testing there were time constraints. This study was no different; however, within the time allocated I was able to achieve meaningful test results. Lack of time in each of the classrooms meant that lessons were either too short or spaced too far apart. Near the end of the unit after the 'in-context' assessment I was unable to be in most of the classrooms when the children tested and evaluated their aids.

Another aspect of the time constraint was for the teachers to spend the classroom time teaching and assessing the unit. Teachers and classrooms are very busy and with today's crowded curriculum, teachers do not have the luxury of spending more time than is absolutely necessary on any one unit of work.

Recommendations

Having completed this project I am able to suggest recommendations for the future practice in the areas of:

- teacher pre-service training
- up-skilling of existing teachers
- type of professional development models
- organisation and development of NEMP Assessment tasks in technology education.

Teacher Education in Technology Education and Teachers

In New Zealand, only the recent *teacher graduates* have experienced teacher training in technology education and limited numbers of teachers have received professional development of any kind in technology education since it was first introduced. It is vitally important that providers of pre-service teacher training plan programmes with an emphasis of authentic technological practice and development of the understanding that teacher knowledge and understanding is key to successful teaching in technology education.

The very positive response I received from schools to my letter offering professional development in technology education and comments from the teachers in the project would support the argument that there is a huge need for professional development in technology education. Quality professional development in technology education is desperately needed if we are going to continue to develop our understanding and the quality of teaching and learning in technology education. Professional development needs to be focused on the *up-skilling of teachers*. This is confirmed by Chamberlain et al. (1999) in their report to the Ministry of Education on the technology education professional development programmes. Teachers indicated a strong desire for continued support and guidance. Jones and Moreland (2001) found the enhancement of teacher knowledge in the four domains of knowledge enhanced children's learning. This is very much supported by the findings of this project. Students' ability to plan technological solutions to meet identified needs improved significantly when the teachers were aware of and guided in the identification of knowledge in all four domains.

According to Joyce and Showers (1995) quality *professional development* needs to include knowledge of relevant theory and other relevant academic content. Bereiter (1992) discusses the need for the development of expert knowledge which comes from problem solving in relative domains. In order for students to be in the position where they are able to investigate and solve relevant problems, teachers too, must be aware of and understand the need for the required knowledge. This empowers teachers to ask the right questions, point students in a variety of different directions and offers the opportunity for quality feedback and feed-forward thus enabling students to develop their own expertise. The three dimensions of teacher expertise identified by Moreland et al. (2000) discussed in Chapter Two are relevant here also. Professional development must also include a positive attitude towards technology and child learning. The development of skills and the transfer of them to classroom instruction are also vital to successful teacher education. I worked with a small group of teachers by firstly introducing them to the theory; because they were voluntary participants they had identified their own need for professional development in technology education prior to my time with them. Supporting the teachers during the delivery of the unit worked very well. All teachers were very positive about technology after the unit. Ideal next steps would be to allow the teachers to plan and teach another unit with less support and guidance from me, then finally moving to planning and teaching a technology unit independently.

Teachers need to be aware of the factors that impact on their ability to plan and on their students' ability to participate in authentic technological practice. Being aware of these factors, in other words knowing what they don't know, may enable teachers to minimise the negative effect they have on their students. Being aware of the importance of quality and relevant teacher knowledge is likely to empower teachers to seek the professional develop they require for teaching a specific unit. Being aware of the administrative and physical constraints of the school will allow teachers to be proactive about seek alternatives where possible and discussing these constraints with their students to that they are aware of the difference between their own practice and that of real technologists.

NEMP - Technology Education Assessment

I understand that the undertaking of a national assessment-monitoring project such as that run by NEMP is a huge undertaking. The size of the project must put limitations on the types of assessment activities that could be undertaken. I think there was clear evidence in this report that achievement levels determined by NEMP, using 'out-of-context' tasks that are not authentic to technological practice and may or may not be authentic to the children's present or possible future lives, are not a true picture of the children tested. The task used in this study did not give a clear indication of actual achievement levels when delivered in the same manner used by NEMP. NEMP may, however, be able to ascertain progression between assessments i.e. the difference in achievement with the same link tasks performed four-years apart can measure progression.

NEMP included tasks from all three strands of *Technology in the New Zealand Curriculum*, but there was no link between the tasks in one strand and that of another. One of the reasons for this is that the tasks are designed to cover all the technological areas of which there are seven: Biotechnology, Food Technology, Electronics and Control Technology, Information and Communication Technology, Materials Technology, Production and Process Technology and Structures and Mechanisms (Ministry of Education, 1995).

Recommendations to NEMP

I would like to recommend one of two suggestions that would enable NEMP to move closer to offering tasks that are authentic to technological practice. Firstly, when offering a Strand B task I suggest providing a range of visual information (photos, pictures or video) and smaller experiences that could enable children to develop knowledge and understanding within the field of practice of the task. These need not be complex or time consuming but designed to give the children relevant information they may then choose to transfer to the NEMP task if they perceive its relevance. This suggestion would be applicable to the various kinds of tasks NEMP offer; individual, group, independent or station.

Or, better still, link Strand A, B and C tasks to the same authentic technological practice so that there is a closer link to authentic technological practice. I imagine that students would participate in all three tasks, within the same technological area and related to the same overall problem. Students could be given first the Strand A and C tasks which would be designed to develop knowledge and understanding that students may use in the following Strand B task. I will illustrate this using the 'Help Me Peel' example. For the first task the children could view the sections of the Vaughan Hill video where Vaughan tells of his frustration about being one-handed and his need to be able to do things for himself and where he shows some examples of what he uses. A task related to Strand C could be to identify the technologies used and how they might impact on an amputee's life. A Strand A task could be to look at three or four pictures of aids and list the features that make it suitable for one-handed people. The Strand B task in this case would be the existing task, the development of an aid to help a one-handed person peel a potato.

I acknowledge that these tasks offer only a snapshot of authentic technological practice but they would help the children realise that the need identified in the picture is authentic and that there are people in our community who either design and/or use such aids. It would also involve them in small parts of the actual practice likely to be undertaken by technologists in the field.

In 2000 28 technology tasks were offered. Eight tasks offered in 2000 were also offered in 1996 - these were link tasks in 1996 but called trend tasks in 2000 because they allow information on trends be obtained. Another nine tasks, new link tasks were not widely reported on because they will be repeated in 2004. The remaining tasks are one–off tasks from all three strands. In 2000 there were fewer from Strand C than the other strands. These were reported in the *Aspects of Technology Education* report published in 2000.

Reorganising the NEMP tasks could involve designing one set of related tasks in each of the seven technological areas, which would give a total of twenty-one tasks. I think this number should be manageable within the existing framework, timelines and general organisation. Those selected for link/ trend tasks could be selected in clusters relating to the same technological practice and therefore within one technological area. The technological areas used here could rotate each assessment. This is by no means ideal as the model does not relate completely to authentic technological practice, but it does move on the continuum towards more authentic assessment tasks.

Future Investigations

A future investigation resulting from this study could be an in-depth investigation into student technological practice and the part teacher intervention plays at different levels in the curriculum. The relationship between teacher knowledge and the quality of intervention and feedback given to students will have direct impact on student learning in technology education in the future. The nature of quality intervention may change as students move through the levels.

Another branch of this is the study of how much knowledge is enough at each level? We already know the children from Levels Four to Eight in *Technology in the New Zealand Curriculum* require specialist teacher input. Is the knowledge of these teachers enough and across all technological areas and how much do general primary teachers need to be effective technology teachers from Levels One to Three?

Finally further investigation into cost effective models of professional development which maximise teacher change while working effectively with students I am sure would benefit this curriculum area.

Conclusion

In order to achieve authentic technological practice in the classroom teachers need to plan units or programmes of work within a framework of sound technological knowledge. It is acknowledged that students' technological practice can never be totally the same as in the field but with a sound theoretical and practical knowledge and careful planning teachers can improve achievement levels of their students. Assessment activities must be planned to be an integral part of student technological practice so that they further students' learning and increase the likelihood of students developing successful technological outcomes.

The results of this study clearly indicate that authentic technological activity positively impacted the results of a selected NEMP task. Children undertook a series of planned activities to enhance their learning within the field of the task. These learning experiences undertaken by the children were clearly linked to the four domains of knowledge identified by the LITE research team. The value of the activities undertaken by the children was enhanced by improved teacher knowledge.

My contribution to technology education through this study is the development of a model of student technological practice. This model furthers the ideas presented by Gawith (2000) that technological practice is purposeful action influenced by the work environment and techniques and skills of the technologist all bounded within society. It also supports the model by Pacey (1983) that technological practice includes organisation and cultural aspects as well as technical aspects.

The Model of Student Technological Practice illustrates how student technological practice is influenced by the educational environment (physical and political) and culture (teacher practice and requirements). I argue that student technological practice is not only restrained by four factors; Institutional Policy and Politics, Teacher Knowledge, Physical Environment and Assessment Requirements but also the role of the teacher. Teacher effectiveness is closely linked to teacher knowledge in the four domains: procedural, conceptual, societal and technical. This study also clearly shows that timely teacher intervention alters student technological practice. The degree to which the intervention improves the students' chances of developing a successful technological outcome will depend on the timing, nature and quality of the intervention which in turn is linked to teacher knowledge. The model highlights the difference between authentic technological practice and student technological practice.

Assessment of student technological practice also needs to reflect the same philosophy of authentic technological practice. Teachers need to identify key stages within their students' practice to assess. This assessment will not be that of separate tasks but an on-going part of student technological practice. Assessment should be formative. Assessment at key stages will allow teachers to determine whether their students are able to continue their practice safely and/or the quality of the tangible outcome. Assessment at these stages will help teachers determine appropriate intervention if necessary. Students need to be able to see the relevance of assessment and it should inform their practice. There is very clear evidence in this study that assessment, which is a part of authentic technological practice, gives a better indication and understanding of children's achievement in technology than assessment tasks that are out-of context.

I therefore make recommendations for the continuation of the quality professional development in technology education for teachers and that they be made aware of the factors which influence the quality of programmes they offer to their students. There are also recommendations to NEMP to develop links between NEMP assessment tasks offered to children in technology, the three stands in *Technology in the New Zealand Curriculum* and authentic technological practice.

Appendices

Appendices Overview

Appendix Number	*Content*
One	***Initial letter to NEMP***
Two	***Follow-up letter to NEMP***
Three	***Initial letter to schools***
Four a	***Acceptance letter to teachers***
Four b	***Acceptance letter to principals***
Five	***Interview One Schedule***
Six	***Letter to NEMP requesting task details***
Seven	***Interview Two Schedule***
Eight	***Letter to parents requesting child's participation***
Nine	***Letter to schools not selected***
Ten	***Help Me Peel unit plan***
Eleven	***Knowledge Identification Sheet Help Me Peel***
Twelve	***Help Me Peel brief***
Thirteen	***Child planning sheet- general class***
Thirteen b	***Child planning sheet -NEMP***
Fourteen	***Child evaluation sheet***
Fifteen	***Material investigation worksheets***
Sixteen	***Criteria for assessment***
Seventeen	***Template for assessment of plans***
Eighteen	***Results***
Nineteen	***NEMP marking schedule***

Appendix One:

Associate Professor Terry Crooks
National Education Monitoring Project
Education Assessment Unit
University of Otago
PO Box 56
Dunedin

Dear Terry,

I am in the process of organising a N.E.M.P. probe study looking into authentic assessment in Technology Education. I believe Dr. Alison Gilmore has shown you the draft proposal. I enclose a copy of the proposal with this letter for your information.

In order to carry out the research necessary for this project I require information about the schools in Christchurch used for the 2000 Technology assessment. In selecting schools for my trial I would like to have the same or similar schools if possible. I realise you may not be able to identify the actual schools for ethical reasons. If not could you please supply me with information on decile rating, geographical location and ethnic make up and another information you are able to supply on the special character of the schools involved.

For this project I will also require a detailed account of the technology tasks used in 2000 and their method of delivery. I need to select the three tasks I wish to study in detail. At a later stage I will be requesting the assessment data collected on the three assessment tasks I select for the project.

Thank you very much for your co-operation in this matter

Yours sincerely,

Wendy Turnbull
Lecturer
Technology Education
Christchurch College of Education

Appendix Two

November 2001

Associate Professor Terry Crooks
National Education Monitoring Project
Education Assessment Unit
University of Otago
PO Box 56
Dunedin

Dear Terry,

Further to my earlier request about the decile ratings of schools used in N.E.M.P. 2000. For my proposed N.E.M.P. Probe Study on the relationship between assessment of tasks in technology education for N.E.M.P.2000 and that of tasks embedded in authentic technological classroom practice I require full details of a task and its administration guidelines and instructions. The task I have selected is: Help Me Peel.
As it is necessary for me to replicate the N.E.M.P. task as closely as possible I would also appreciate the use of any equipment and materials used for the selected tasks. I intend to administer each of the task in three classrooms selecting 6-7 children from each class, 18-21 children for each task.

Don't hesitate to contact me if you require further information. My work phone number is 03 3437780 Ext. 8124. Your help and support in this matter is greatly appreciated

Yours sincerely,

Wendy Turnbull
Lecturer
Technology Education
Christchurch College of Education

Appendix Three

November 2001

The Principal

Dear Sir/ Madam

I have a passion for the development on quality technology education programmes in primary schools and to this end I am conducting a N.E.M.P. Probe Study on the relationship between assessment of tasks in technology education for N.E.M.P.2000 and that of tasks embedded in authentic technological classroom practice. This study is a part of my thesis for Master of Teaching and Learning at the Christchurch College of Education.

To undertake this study I am looking for six Year 4 classes with enthusiastic classroom teachers to participate in the field work section of the study. I require two classes from schools in each of the SES levels determined by N.E.M.P.: Level 1, deciles 1-3; Level 2, deciles 4-7 and Level Three, deciles 8-10.

The first stage of the study will involve the classroom teacher professional development in technology education unit planning. I will be using the latest research for Massey and Waikato universities and the cooperative planning of a unit that can be taught in the three schools also incorporating a previously identified N.E.M.P. assessment task. This should involve half a day before and after the classroom work, for which release payments will be made.

The second stage will involve the team teaching of the technology unit- preferably in Term Two. I will be involved in as much teaching of the unit as is possible.

The third stage will involve 6-7 children selected from each class to repeat the one N.E.M.P. assessment task as an integrated part of the unit. These results will be compared to the results of the same task administered by N.E.M.P. in 2000.

At all times the anonymity of the classroom teacher, school and children will be ensured. The information collected will be confidential to the relevant classroom teacher, my thesis supervisors and markers and myself. All data gathered by me will be kept in a secure environment. The results will be published as my thesis and a report will be sent to the National Education Monitoring Project. I also intend to write a journal article, which will be submitted, to an international journal in technology education. Schools, classroom teachers and students will not be identifiable in the written work of this project.

If you have a teacher of Year 4 children who would be interested in joining my project, please return to me the form below, by December10 2001.

Thank you very much for taking the time to read my letter and considering this proposal.

Yours sincerely,
Wendy Turnbull
Lecturer in Technology Education and Professional Studies
Christchurch College of Education

I ________________ (name) am interested on the being a part of the N.E.M.P. probe study on Assessment in Technology Education. I will be teaching a Year 4 class at ________________ School in Christchurch. I understand this will involved professional development time out of the classroom and co operative teaching with the researcher. Our school has a current decile rating of______. I also understand six classes with a range of decile ratings will be selected.

Signed:________________________ Date:______________
Principal:______________________
School:________________________

Please return to Wendy Turnbull, Christchurch College of Education, P.O. 31065, Chch.

Appendix Four(a)

Selected Teacher

8 February 2002

Dear

Thank you very much for agreeing to be a part of my study on technology education tasks embedded in authentic technological classroom practice. I look forward to meeting you and working with you this year.

The first stage of the study will involve the classroom teacher professional development in technology education unit planning using the latest research for Massey and Waikato universities. Cooperative planning of a unit that can be taught in the six schools and incorporate a N.E.M.P. assessment task embedded in the unit will also be facilitated. This should involve a day at the beginning of the year. I will also be conducting a semi-structured interview with you about the proposed teaching before the unit is taught and the actual teaching after the unit has been taught in the classroom.

The second stage will involve both of us team teaching of the technology unit-preferably in Term Two. I will be involved in as much teaching of the unit as my College timetable allows. Results from randomly selected six children from your class will be analysed. Some classes may involve a form of pretest.

At all times your anonymity and that of the school and children will be ensured. The information collected will be confidential to you, my thesis supervisors and markers and myself. All data gathered by me will be kept in a secure environment .The results will be published as my thesis and a report will be sent to the National Education Monitoring Project. I also intend to write a journal article, which will be submitted to an international journal in technology education. You will be welcome to a copy of the results if you are interested. Schools, classroom teachers and students will not be identifiable in the written work of this project.

The details of our professional development day are as follows. It will be on March 14 2002 in the primary technology classroom at the College of Education starting at 8.30 p.m. The closest place to park will be Car Park Two.

Yours sincerely,

Wendy Fox-Turnbull
Technology Education
Christchurch College of Education

Appendix Four(b)

Principal of Selected Teacher

8 February 2002

Dear

Thank you very much for allowing---------------- to be a part of my study on the relationship between assessment of tasks in technology education for N.E.M.P.2000 and that of tasks embedded in authentic technological classroom practice. I look forward to meeting you and working with your staff member.

The first stage of the study will involve the classroom teacher professional development in technology education unit planning using the latest research for Massey and Waikato universities and the cooperative planning of a unit that can be taught in the three schools and incorporate a N.E.M.P. assessment task embedded in the unit. This should involve a day of professional development at the beginning of the year. All release time will be paid for as a part of the study. I will also be conducting a semi-structured interview with my teachers about the proposed teaching before the unit is taught and actual teaching after the unit has been taught in the classroom.

The second stage will involve both of us team teaching of the technology unit- preferably in Term Two. I will be involved in as much teaching of the unit as my College timetable allows. Results from randomly selected six children from your class will be analysed. Some classes may involve a form of pretest.

At all times the anonymity of the classroom teacher, the school and children will be ensured. The information collected will be confidential to you, my thesis supervisors and markers and myself. The results will be published as my thesis and a report will be sent to the National Education Monitoring Project. I also intend to write a journal article, which will be submitted, to an international journal in technology education. Schools, classroom teachers and students will not be identifiable in the written work of this project. You will be welcome to a copy of the results if you are interested.

I will be in contact with you shortly to arrange the professional development days with the classroom teachers.

Best Wishes for the festive season.

Yours sincerely,

Wendy Fox-Turnbull
Lecturer
Technology Education
Christchurch College of Education

Appendix Five

Semi Structured Interview One-Questions
Intended Practice

Informal questions to set the tone of the interview

1. Describe the school and the community?
2. How many children do you have in your class? Are they a typical cross section of children in the school?
3. Describe the make up of the class: Gender, Ethnicity; Cultural Differences
4. Describe the general behaviour of the class

Questions related to the unit to be taught

5. Discuss the intended unit to be taught, giving details about the tangible outcome and the associated technological area and context
6. Discuss any major organisation that needs to be attended to before the unit is begun in the classroom
7. Discuss the intended strategies you plan to use during the teaching of the unit
8. Describe generally how you see the unit progressing in this class.
9. How do you feel about teaching the planned unit?
10. What aspects of the professional development have made most impact on your understanding of technology education?

Appendix Six

November 2001

Associate Professor Terry Crooks
National Education Monitoring Project
Education Assessment Unit
University of Otago
PO Box 56
Dunedin

Dear Terry,
Further to my earlier request about the full details of two the following tasks and their administration guidelines and instructions. The two tasks I selected were:
1
2.
For my proposed N.E.M.P. Probe Study on the relationship between assessment of tasks in technology education for N.E.M.P.2000 and that of tasks embedded in authentic technological classroom practice I now require a copy of the full results and all data gathered for the above tasks. I understand that all results sent to me will be anonymous.

I continue to appreciate your support in this matter. Don't hesitate to contact me if you require further information. My work phone number is 03 3437780 Ext. 8124.

Yours sincerely

Wendy Turnbull

Appendix Seven

Semi Structured Interview Two- Questions

Actual Practice

Informal questions to set the tone of the interview

1. Describe the changes in the make up of the class since the initial interview
2. How do you feel about the participation of the class during the unit
3. What was the general attitude of the children to the technology unit of work?

Questions related to the unit to be taught

4. Discuss the actual unit taught, giving details about the tangible outcomes developed by the children during the unit.
5. Discuss any major organisation that was needed that you had not anticipated or planned for initially.
6. Discuss the actual strategies you actually used during the teaching of the unit
7. Describe generally how you saw the unit progressed in this class.
8. How did this differ from what you initially thought?
9. Why do you think these changes occurred.
10. Please comment on the children's attitudes to the unit
11. What are your opinions about how the learning that occurred for the children and their response to it.
12. What aspects of the whole process have made most impact on your understanding of technology education?

Appendix Eight

February 2002

Dear Parents

My name is Mrs. Wendy Fox-Turnbull. I am a lecturer in Technology Education at the Christchurch College of Education. I have a passion for the development on quality technology education programmes in primary schools and to this end I am conducting a study of assessment in technology. This study is a part of my thesis for Master of Teaching and Learning at the Christchurch College of Education.

To undertake this study I am working with six Year 4 classes with their enthusiastic classroom teachers to plan, teach and assess a unit of work in technology. Your child's class has been selected as one of these classes. This will mean that I will be teaching cooperatively with the classroom teacher during the duration of the technology unit.

Assessment data from six children in the class will be gathered and recorded either visually, orally or as a written task, for me to then take away to analyse further. These children will be selected to ensure I have a thorough mix in terms of ability, cultural background and gender. If you are happy for your child to be one of these children please fill in and return the form below to your classroom teacher as soon as possible.

At all times the anonymity of the classroom teacher, school and children will be ensured. The information collected will be confidential to the relevant classroom teacher, my thesis supervisors and markers and myself. All data gathered by me will be kept in a secure environment. The results will be published as my thesis and possibly other articles. Schools, classroom teachers and students will **not** be identifiable in the written work of this project.

Thank you very much for taking the time to read my letter and considering assisting me in my study.

Yours sincerely,

Wendy Turnbull
Lecturer in Technology Education and Professional Studies
Christchurch College of Education

I ______________________ (name) am happy for my child ____________________(child's name) to be a part of the assessment study in technology education. I understand this may involved my child's assessment activities being recorded and further analysed in a confidential manner

Signed:__________________________ Date:______________

School:__________________________

Please return to your child's classroom teacher as soon as possible

Appendix Nine
Letter to schools not selected

8 February 2002

Dear

Thank you very much for agreeing to be a part of my study on technology education tasks embedded in authentic technological classroom practice. Unfortunately I am unable to accommodate you in this study but hope to be able to offer similar opportunities in the future. I have been over whelmed with the support I have received from Christchurch Primary schools. I thoroughly appreciate this support. The method of selection used was to take the first two replies from each of the three decile bands.
I apologise for any inconvenience this may have caused you.

Yours sincerely

Wendy Fox-Turnbull

Technology Unit Planner   Estimated Time:

Topic: Help Me Peel   Level: 2

Stimulus/ Creating Interest-
One lunchtime Amy fell off the jungle gym and broke her arm. Amy loves to help at home and is worried that she will not be able to peel potatoes.

Human Need or Opportunity:
Develop and aid that will allow Amy to peel the potatoes by herself using an everyday peeler

Coverage: Strand

Achievement Objectives:

	A: Knowledge and Understanding						B: Technological Capability				C: Tech & Soc	
	1	2a	2b	3	4	5	6a	6b	6c	6d	7	8
	✓	✓	✓				✓	✓	✓	✓	✓	

Tick coverage and highlight assessment. All units of work must cover all AO 6. Learning in all three strands must be evident in all units also.

Technological Areas: (justify)
Major Focus: Materials Technology
The children will investigate and select a suitable material for their aid.
Minor Focus: Structures and Mechanisms
Children will also be exposed to kitchen mechanisms and structures when investigating and designing their aid

Essential Skills: (highlight)
Communication
Physical
Problem Solving
Numeracy
Information
Self Management and Competitive
Social and Cooperative
Work and Study

Contexts: (relates to identified need)
Home. The aid to help people in their home

Health and Safety Considerations
Teach safe use of:
scissors and cutters for cutting plastic
hammers and nails
hot glue guns
Teach
sensitivity towards people with disabilities (particularly if a face to face speaker is involved not in a video as planned here)
cultural sensitivity when dealing with food products. Always use food products for actual consumption
healthy practice when peeling vegetables and preparing vegetables for eating (Carrot sticks with dip and potato wedges)

Resources

Materials/ Equipment
Paper for planning and mock-up designs
Range of materials for investigation into durability, reaction to water, strength and 'scrubability': styrene plastic, Vivac plastic, ice cream container plastic, coreflute plastic, polystyrene?, customwood, cardboard etc. Also available for construction
paperclips, split-pins, nails and hammers, hot glue and guns,

Information/ Community Resources
Video of Vaughan Hill an amputee - Wendy Fox-Turnbull CCE
New Zealand Disability Resource Centre
Enable Information New Zealand 0800 17 1981
Equipment Management Services 0800 17 1995
Pictures of aids developed for people with one hand
Cutting C. 1998. *Arthritis Information and Advice for New Zealanders for Arthritis Foundation New Zealand* New Zealand Health Series. Wellington: GP Publications

Unit Summary:
- experience peeling first carrots and then potatoes to ensure they are familiar with the task required of Amy
- view the video of Vaughan Hill an amputee who lost his arm below the elbow in a shark attack. Vaughan discusses his disability and how he feels about doing things for himself and how he adjusted to life with only one arm. He also talks about the things he uses to help him.
- children experience a lunch time with an arm under their jersey and discuss their frustrations and challenges
- investigation into who, and why people have the use of one arm (arthritis, amputees, broken or dislocated, birth conditions)
- investigation by studying a series of pictures of aids available for those who have the use of only one arm
- identification of criteria needed for Amy's aid
- investigation into suitable materials for aids. They will heed to be scrubbed and washed, lightweight and aesthetically pleasing
- as individuals sketch two or three initial ideas and select one
- justify selection to T or a group of peers
- take selected idea and develop fully into an annotated plan of aid, include size, materials used and explanation as to how it makes it easier to peel a potato
- make a mock up of design using cardboard, make modification to initial designs if necessary
- make to final model of the aid and test by peeling a potato
- evaluate designs and discuss final product and the differences compared to the model produced

Vocabulary (new to children)
amputee
Arthritis
mock-up
model
Prosthesis
design
annotate
ergonomics
suction

Strand	Learning Experiences: The Children will…..	Learning Outcomes: The students can…..	Links to AO	Criteria for Assessment
A	experience peeling first carrots and then potatoes to ensure they are familiar with the task required of Amy	successfully peel a carrot and a potato (T to ensure that the carrots and potatoes are eaten-carrot sticks and dip, potato wedges)	1, 2b	
C	view the video of Vaughan Hill an amputee who lost his arm below the elbow in a shark attack. Vaughan discusses his disability and how he feels about doing things for himself and how he adjusted to life with only one arm. He also talks about the thing he uses to help him.	talk about how they would feel having only one arm and draw/list five things they wouldn't be able to do by themselves if they had the use of only one arm	7	
C	experience a lunch time with an arm under their jersey and discuss their frustrations and challenges		7	
A / C	investigate who, and why people have the use of one arm (arthritis, amputees, broken or dislocated, birth conditions). Question parents/ grandparents for some answers here (suggestion only)	discuss in pairs reasons for one arm loss and report to the whole class	1, 2a, 7	Children should be able to identify at least four of the following necessary characteristics of existing aids ▪ Aids hold the object still or in place ▪ Task completed at waist height (aprox.) if the person is standing or sitting ▪ Often plastic ▪ Easy to assemble, get out and put away ▪ Some use suction to hold the aid still ▪ Some use spikes to hold things still ▪ Size of the aid is relative to the average size of what it is being used for ▪ Look good
A	investigate by studying a series of pictures of aids available for those who have the use of only one arm	list four common features of aids for people with only one arm	1,2a	
A	investigation into suitable materials for aids. They will heed to be scrubbed and washed, lightweight and aesthetically pleasing	name three suitable materials and give at least one reason for why they are suitable		
B	recall the above learning experiences and identify criteria needed for Amy's aid	as a class list the criteria needed for a successful aid to help Amy peel her potatoes	5	

Strand	Learning Experiences: The Children will…..	Learning Outcomes: The students can…..	Links to	Criteria for Assessment
B	as individuals sketch two or three initial ideas and select one	discuss their sketches with a partner or T, giving clear explanation as to how each one will work	6c	Criteria: A successful aid will have most of these criteria: ▪ provide stability for the potato ▪ hold still while the potato is being peeled ▪ be washable ▪ light weight ▪ allow a potato to be peeled by one person only ▪ allow for the whole potato to be peeled ▪ remain still while the potato is put on and lifted off ▪ be easy to use and put away with no setting up
B	justify selection to T or a group of peers, clearly stating reasons for selection of one over other designs	and discuss their final selection, giving clear reasons about their final selection		
B	take selected idea and develop fully into an annotated plan of aid, include size, materials used and explanation as to how it makes it easier to peel a potato	on a sheet of A4 paper as an individual complete detailed annotated plans for their designs include size, materials used and explanation as to how it makes it easier to peel a potato	6b, 6c	
B	make a mock up of design using cardboard, make modification to initial designs if necessary	make mock up and discuss difficulties experienced and make changes to initial plans if necessary (put changes on the plan in a different colour, helps assessment later)	6b, 6d	
B	make to final model of the aid and test by peeling a potato	develop and test their model aid to peel a potato	6b	
B	evaluate designs and discuss final product and the differences compared to the model produced	list changes that they could make to improve their design and list three things that would be different if the aid is produced for a shop (commercially)	6d	

Unit By Wendy Fox-Turnbull, Joan Coakley, Karen Loo, Danielle Brown, Judy Walker, Nicki MacKenzie and Catherine Bell CCE Technology Research Project 2002
Planner v9 by Wendy Turnbull and Fiona Haynes 2000 adapted from planner by Paul Rodley, Dave Sim and Wendy Turnbull 1997

K.Id Sheet **Knowledge Identification in Technology** **Help Me Peel**

Level: 2 **Year:** 4 **Technological Areas – Major Focus:** Material **Minor Focus:** Structures & Mechanisms

Task Definition: Develop an aid to peel a potato for a person with one disabled arm. The person will use a normal peeler and have no other help.

Intended Practice

Experience the peeling of carrots and potatoes and to experience a lunch time without the use of an arm
Develop an awareness that loss of arm use can happen through a variety of way
Develop and apply an understanding of the features of aids for people with arm disabilities

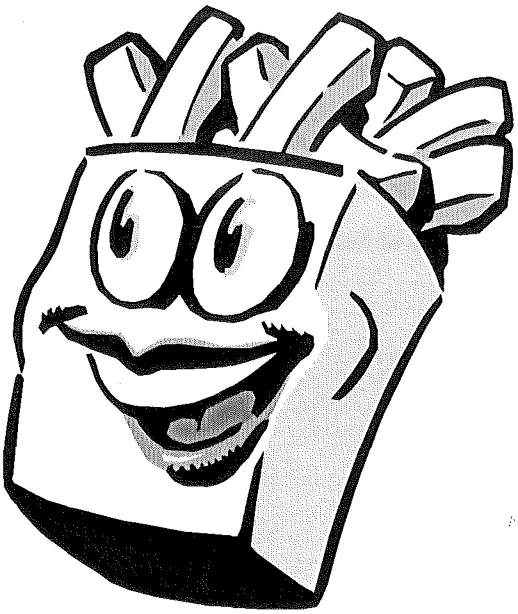
Recognise that different people value different features for different reasons.

Investigate a range of aids used by people with the use of only one arm
Test and select and use appropriate materials when producing a model potato peeler aid.
Relate construction of their mock-up to the concept and presentation drawings.

	Procedural	Conceptual	Societal	Technical
Specific	**To:** ▪ peel a carrot and a potato using a standard peeler and experience the action and movement necessary ▪ examine a wide range of aids and determine needs / criteria for design and construction ▪ examine and test a range of suitable materials for the model ▪ ensure all materials and equipment suitable for constructing an aid to peel a potato peeler are available	**To understand:** ▪ a hand aid usually increases stability to an object ▪ the relationship between the potato and the aid ▪ suitable materials for an model aid may be plastic (styrene, vivac, coreflute), customwood, metal, rubber ▪ spikes and /or suction are useful for stability ▪ suitable criteria may be: increases stability of potato, cleanable and scrubable, easy to use, can peel potato on own, can peel whole potato, only one hand needed for the whole operation	**To understand:** ▪ how people feel about being disabled- the challenges and frustrations ▪ how people adjust to a new disability	**To:** ▪ use a potato peeler to first peel a carrot (straight action) and then a potato ▪ safely use a craft knife ▪ safely use a hot glue gun ▪ score a card (make a mock-up if time allows)
Generic	▪ make annotated concept drawings of their design ▪ make annotated detail drawings of the significant features to be included in their design ▪ make a 3D presentation drawing ▪ construct model of their design . ▪ evaluate according to negotiated criteria such as user-friendliness, modification, adaptation, ergonomics, reliability, fitness for purpose.	▪ function is more important than aesthetics in designing an aid ▪ anthropometrics is the study of the human form that informs the use of ergonomics in design (optional as extension) ▪ that there is a sequence to the process of concept, detail and presentation drawings and modeling. ▪ the following terminology and use it appropriately: ergonomics, functional, user-friendly, model, reliable.	▪ different people find different features more important. ▪ reducing the time taken to do a task can improve working conditions. ▪ the concept of mass production related to provision of perishable goods.	▪ produce a concept drawing with notes. ▪ produce detail drawings – 3D and 2D as required. ▪ produce a presentation drawing in 3D with notes. ▪ use the following processes, tools and / or materials as appropriate for producing a realistic model ➢ safely adhering surfaces (stapler, gluing, tabs) ➢ assembling mixed materials(metal, wood, plastic) ➢ using a hand saw ➢ using a hand electric drill ➢ safely use a potato peeler

Adapted from © LITE (Assessment) Project 2000, University of Waikato by Fiona Haynes & Wendy Turnbull CCE, 2001
Unit By Wendy Fox-Turnbull, Joan Coakley, Karen Loo, Danielle Brown, Judy Walker, Nicki MacKenzie and Catherine Bell 2002

Help Me Peel

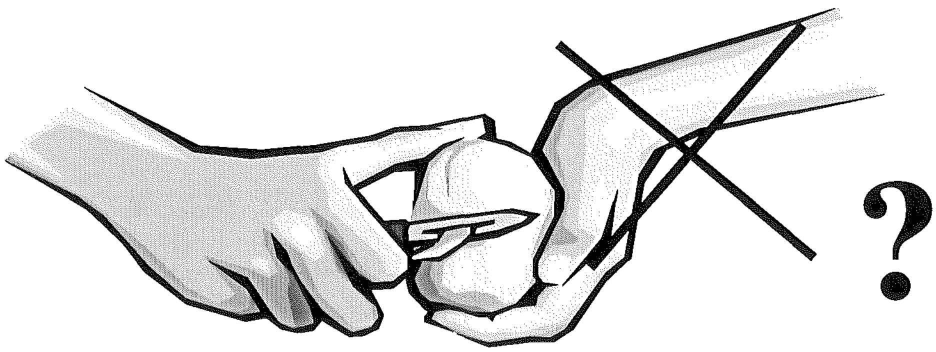


Situation:
One lunch time Amy fell off the jungle gym and broke her arm. Amy loves to help at home and she is worried that she will not be able to peel the potatoes.

Need:
Develop an aid that will allow Amy to peel the potatoes by herself, using an everyday potato peeler.

Things to Think About:

How can you hold a potato and a peeler if you only have one hand?
What are the most suitable materials?
What is the best way to join the materials you have chosen?
How will you clean it?
How will you get the aid out, set it up and put it away?
How big should it be?
Can *you* peel a potato easily using the aid
How do 'one-handed' people feel about doing things for themselves?



Appendix Thirteen
Planning Sheet For Children not Involved in In-context Task

Help Me Peel **My Plan**

Name:_____________ Date:_______________

A way to make it easier to peel a potato using only one hand

Appendix Thirteen (b)
Planning Sheet for Children Involved in In-context Task

NEMP National Education Monitoring Project	Supplies	TEC16/48 /S /00 B
	Instruction card photo	

Help Me Peel

Read the instruction card and draw your plan here.

My Plan
A way to make it easier to peel a potato using only one hand.

Help Me Peel   Evaluation Sheet

Name:______________________________

Draw a circle around the correct answer

I can peel a potato.	Yes	No
I can use my aid to peel a potato with one hand.	Yes	No
I can peel the whole potato using my aid.	Yes	No
Someone else can use my aid to peel a potato with one hand.	Yes	No
My aid keeps the potato still while I peel it with one hand.	Yes	No
My aid can be cleaned and scrubbed.	Yes	No
My aid keeps still while I use it.	Yes	No

Write answers to the following questions

1. What materials did you use to make your aid?

2. Why did you select these materials?

3. What do you like best about your aid?

4. What would you change if you were to do it again?

5. How do you feel about the way you worked during the Help Me Peel unit? Why?

Help Me Peel

Investigation into Materials suitable for Aids for One Handed People

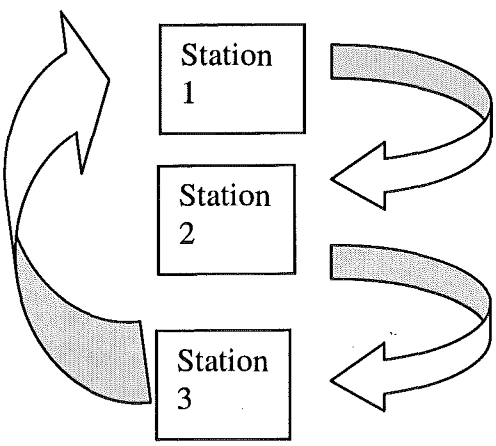
Suggestions
Materials
Coreflute
Cardboard
Customwood
Painted Customwood
Polystyrene
Styrene plastic (similar to margarine pottle plastic)
Vivac Plastic (similar to ice cream container plastic)
Bubble Plastic
Plastic Matting

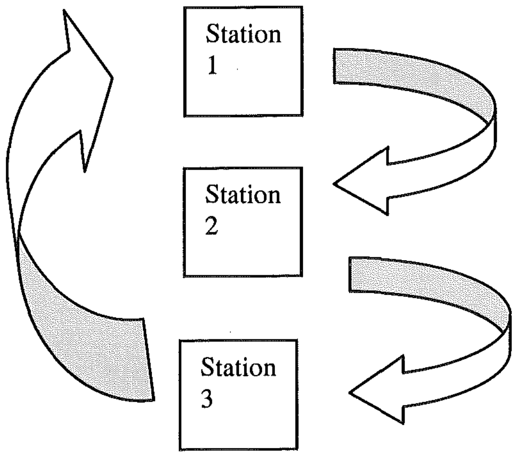
Stations for Testing
Station One
Washing and Scrubbing
-Ability to be thoroughly washed and cleaned

Station Two
Durability
Can the material be bent without damage?
Can you rip the material?

Station Three
Slippery or Stability
Rank the material for easy to hardest to slide across a desk or bench top

Requirements for each class
Each class is divided into six even groups. Two for each of three stations. Children rotate around in one group to one set of three stations, complete the investigations and fill in the form provided.





Materials Investigation Worksheet **Names:**______________________________

Materials	*Station One* **Can the material be washed and Scrubbed?**	*Station Two* **Can the material be bent and ripped?**	*Station Three* **Does the material slip easily across the bench?**
Instructions Answer all questions with either no or yes.	Take a piece of each material and put it in water. 1. Is the material damaged by the water? 2. Can the material be scrubbed in soapy water?	Take a piece of each material then try bend it and rip it. 1. Can the material be bent without damaging it? 2. Can you rip the material?	Take a piece of each material and push it along a desk or bench 1. Does the material slip across the desk or bench easily?
a. Coreflute	1. 2.	1. 2.	
b. Cardboard	1. 2.	1. 2.	
c. Customwood (unpainted)	1. 2.	1. 2.	
d.Painted Customwood	1. 2	1. 2.	

e. Styrene (white)	1. 2	1. 2.	
f. Vivac(clear)	1. 2.	1. 2.	
g. Polystyrene	1. 2.	1. 2.	
h. Plastic Matting	1. 2.	1. 2.	
i. Bubble Plastic	1. 2.	1. 2.	

The Materials I think are best for my aid are:

These materials are best because….

Help Me Peel - Criteria for Assessment of Plans

'3'- Score given

Quality of the idea/solution Its workability	**Clearly Workable** 3	**Probably workable** 2	**Possibly Workable** 1	**No Solution/ unworkable solution** 0
	• Able to keep potato still- e.g. cup, two nails/sticks • Able to be held secure on the bench-plastic matting or suction cups • Appropriate size and materials • Can be used by a one handed person	• May keep potato still-, one nail/stick • Aid may be held secure on the bench • Size and materials not clearly stated • May be able to me used by a one handed person	• Keeping the potato still considered but probably won't do it • No way to secure aid to bench • Size not considered • Materials not considered • Probably won't work	• Won't keep the potato still • Can't be secured to bench • May be futuristic and little likelihood of being able to be produced now or in the future • No solution offered
Quality of Plan/ diagram/ picture Independent of its workability		**Quite detailed** 2	**Rudimentary** 1	**No plan/diagram/picture Scored if there is no plan/ picture/ diagram offered** 0
Quality of Explanation		**Quite detailed** 2	**Rudimentary** 1	**No Explanation Scored if there is no explanation** 0
		• Discusses how it will make it easier to peel the potato • Explanation expands on information given in the diagram/picture	• Discusses the picture but gives little or no relevant information on their design	• No explanation offered

Criteria for Assessment of Plans (Continued)

Nature of solution	Ways of holding potato still (so can be operated with a single hand) 5	Ways of holding aid still (so can be operated with a single hand) 5	Ways of holding peeler still (so can be operated with a single hand) 4	Machine 3	Getting somebody else to help by holding (so you can peel potato with a single hand) 2	No Workable Solution/ any other response 0
	Will offer at least one of the following: nails at least two, split pins or skewers, cup formation holes or wedge for the potato	Will have at least one of the following: matting on the bottom, suction pads on the bottom, clamp to clamp to bench or table, method of trapping the device	A device that holds the peeler still so the potato can moved against the blade Must mention the moving of the potato against the blade	Will use electricity May have a motor Possibly be futuristic	Will involve another hand or other hands in the operation	Solution unable to be made and or unrealistic for the intended purpose

Help Me Peel - Criteria for Assessment of Plans

'3'- Score given ▢ Pre Unit Task Scores ▢ In Unit Task Scores

Quality of the idea/solution Its workability	**Clearly Workable** 3	**Probably workable** 2	**Possibly Workable** 1	**No Solution/ unworkable solution** 0	Totals
School Decile	• Able to keep potato still- e.g. cup, two nails/sticks • Able to be held secure on the bench-plastic matting or suction cups • Appropriate size and materials • Can be used by a one handed person	• May keep potato still-, one nail/stick • Aid may be held secure on the bench • Size and materials not clearly stated • May be able to me used by a one handed person	• Keeping the potato still considered but probably won't do it • No way to secure aid to bench • Size not considered • Materials not considered • Probably won't work	• Won't keep the potato still • Can't be secured to bench • May be futuristic and little likelihood of being able to be produced now or in the future • No solution offered	
School A 10					
School C 6					
School E 3					
School A 10					
School B 10					
School C 6					
School D 6					
School E 2					
School F 3					

Quality of Plan/ diagram/ picture Independent of its workability		**Quite detailed** 2	**Rudimentary** 1	**No plan/diagram/picture Scored if there is no plan/ picture/ diagram offered** **0**	Totals
School Decile		• May offer two views • Measurements given • Most Materials mentioned	• Plan draw with no annotation • No measurements • Picture very basic	• No solution offered	
School A 10					
School C 6					
School E 3					
School A 10					
School B 10					
School C 6					
School D 6					
School E 2					
School F 3					
Total					

Quality of Explanation		**Quite detailed** 2	**Rudimentary** 1	**No Explanation Scored if there is no explanation** **0**	Totals
School Decile		• Discusses how it will make it easier to peel the potato • Explanation expands on information given in the diagram/picture	• Discusses the picture but gives little or no relevant information on their design	• No explanation offered	
School A 10					
School C 6					
School E 3					
School A 10					
School B 10					
School C ***6***					
School D 6					
School E ***2***					
School F 3					
Total					

Criteria for Assessment of Plans (Continued)

Nature of solution	**Ways of holding potato still** (so can be operated with a single hand) 5	**Ways of holding aid still** (so can be operated with a single hand) 5	**Ways of holding peeler still** (so can be operated with a single hand) 4	**Machine** 3	**Getting somebody else to help by holding** (so you can peel potato with a single hand) 2	**No Workable Solution/ any other response** 0	Totals
	Will offer at least one of the following: nails at least two, split pins or skewers, cup formation holes or wedge for the potato	Will have at least one of the following: matting on the bottom, suction pads on the bottom, clamp to clamp to bench or table, method of trapping the device	A device that holds the peeler still so the potato can moved against the blade Must mention the moving of the potato against the blade	Will use electricity May have a motor Possibly be futuristic	Will involve another hand or other hands in the operation	Solution unable to be made and or unrealistic for the intended purpose	
School A 10							
School C 6							
School E 3							
School A 10							
School B 10							
School C 6							
School D 6							
School E 2							
School F 3							
Total							

Results of 'Out-of-context' Task by Test School (in percentage of students scored)

Quality of the idea/solution- Its workability

	Clearly Workable	*Probably workable*	*Possibly Workable*	*No Solution/ unworkable solution*
School A	33	17	50	0
School C	0	0	20	80
School E	17	0	17	67
Total	**18**	**6**	**29**	**47**

Quality of Plan/ diagram/ picture-Independent of its workability

	Quite detailed	*Rudimentary*	*No plan/ diagram/ picture*
School A	0	100	0
School C	0	100	0
School E	0	100	0
Total	**0**	**100**	**0**

Quality of Explanation

	Quite detailed	*Rudimentary*	*No Solution*
School A	33	67	0
School C	20	80	0
School E	0	100	0
Total	**18**	**82**	**0**

Nature of solution

	Ways of holding potato still	*Ways of holding aid still*	*Ways of holding peeler still*	*Machine*	*Getting somebody else to help by holding*	*No Workable Solution*
School A	67	33	0	33	0	17
School C	0	0	0	20	20	60
School E	33	0	0	0	0	67
Total	**33**	**12**	**0**	**18**	**6**	**47**

Results of 'In-context' Task by School (in percentage of students scored)

Quality of the idea/solution
Its workability

	Clearly Workable	*Probably workable*	*Possibly Workable*	*No Solution/ unworkable solution*
School A	67	33	0	0
School B	50	0	33	17
School C	67	33	0	0
School D	67	33	0	0
School E	67	33	0	0
School F	83	0	17	0
Total	**67**	**22**	**8**	**3**

Quality of Plan/ diagram/ picture
Independent of its workability

	Quite detailed	*Rudimentary*	*No plan/ diagram/ picture*
School A	67	33	0
School B	50	50	0
School C	83	17	0
School D	100	0	0
School E	50	50	0
School F	50	50	0
Total	**67**	**33**	**0**

Quality of Explanation

	Quite detailed	*Rudimentary*	*No Solution*
School A	100	0	0
School B	50	50	0
School C	67	33	0
School D	83	17	0
School E	67	33	0
School F	83	17	0
Total	**75**	**25**	**0**

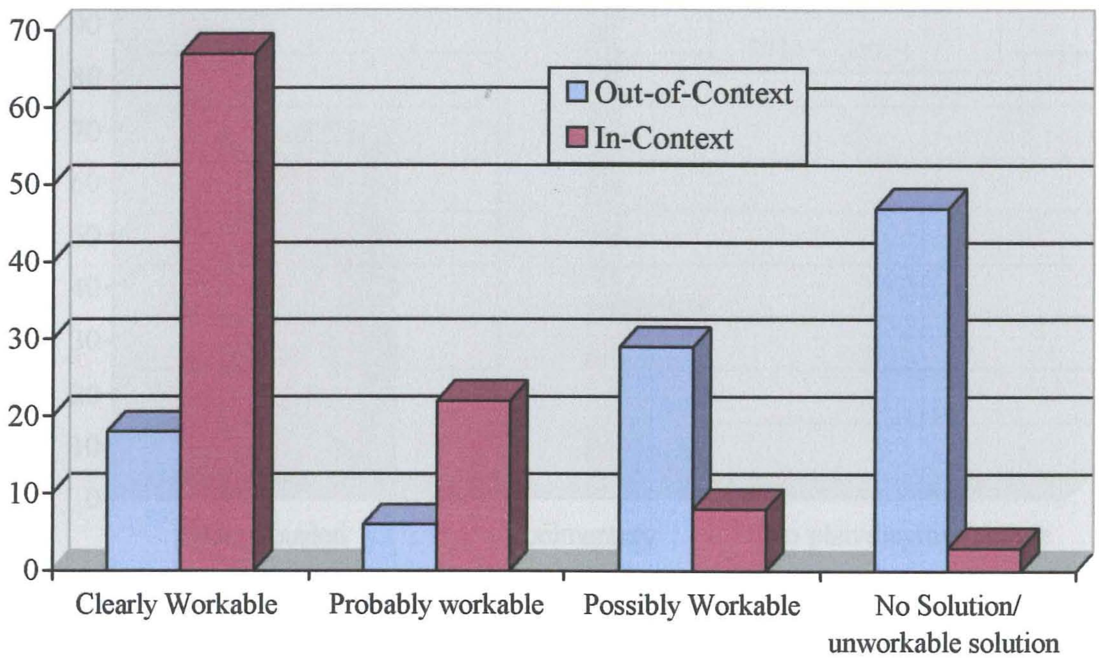
Nature of solution

	Ways of holding potato still	*Ways of holding aid still*	*Ways of holding peeler still*	*Machine*	*Getting somebody else to help by holding*	*No Workable Solution*
School A	83	83	0	0	0	0
School B	76	33	0	0	0	17
School C	100	67	0	0	0	0
School D	100	83	17	17	0	0
School E	100	83	0	0	0	0
School F	83	67	0	0	0	0
Total	**86**	**69**	**3**	**3**	**0**	**3**

Results of 'Out-of-context' Task compared to 'In-context' Task (in percentage of total students scored)

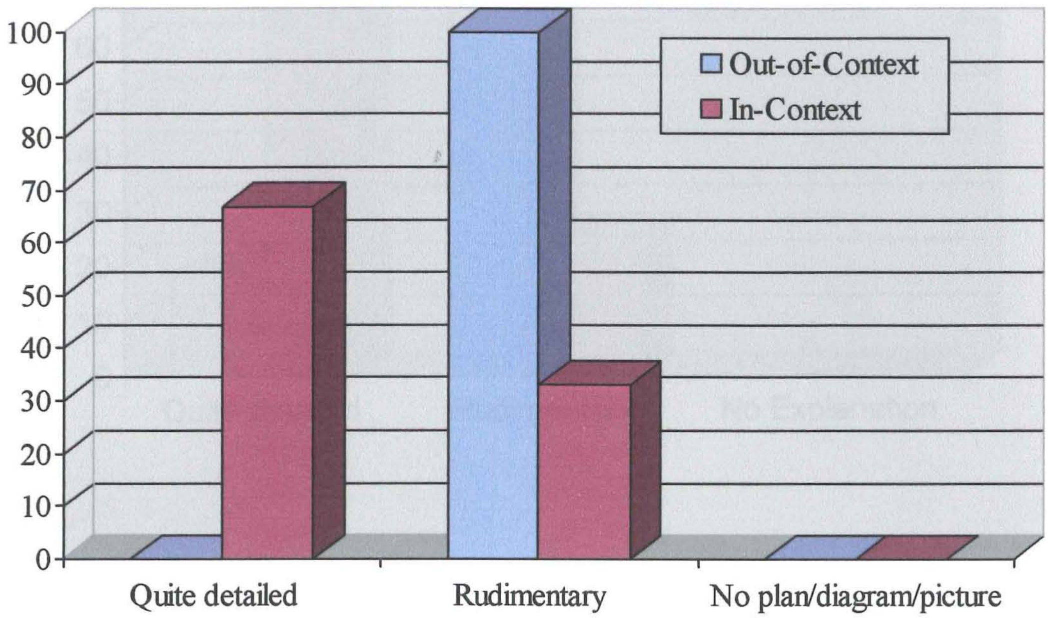
Quality of the idea/solution-Its workability

	Clearly Workable	*Probably workable*	*Possibly Workable*	*No Solution/ unworkable solution*
Out-of-Context	18	6	29	47
In-Context	67	22	8	3



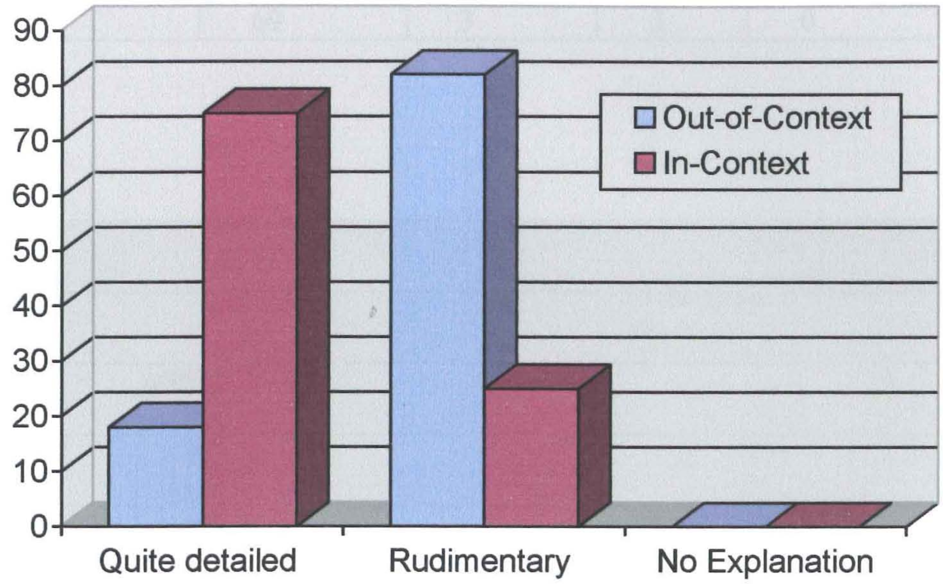
Quality of Plan/ diagram/ picture
Independent of its workability

	Quite detailed	*Rudimentary*	*No plan/ diagram/picture*
Out-of-Context	0	100	0
In-Context	67	33	0



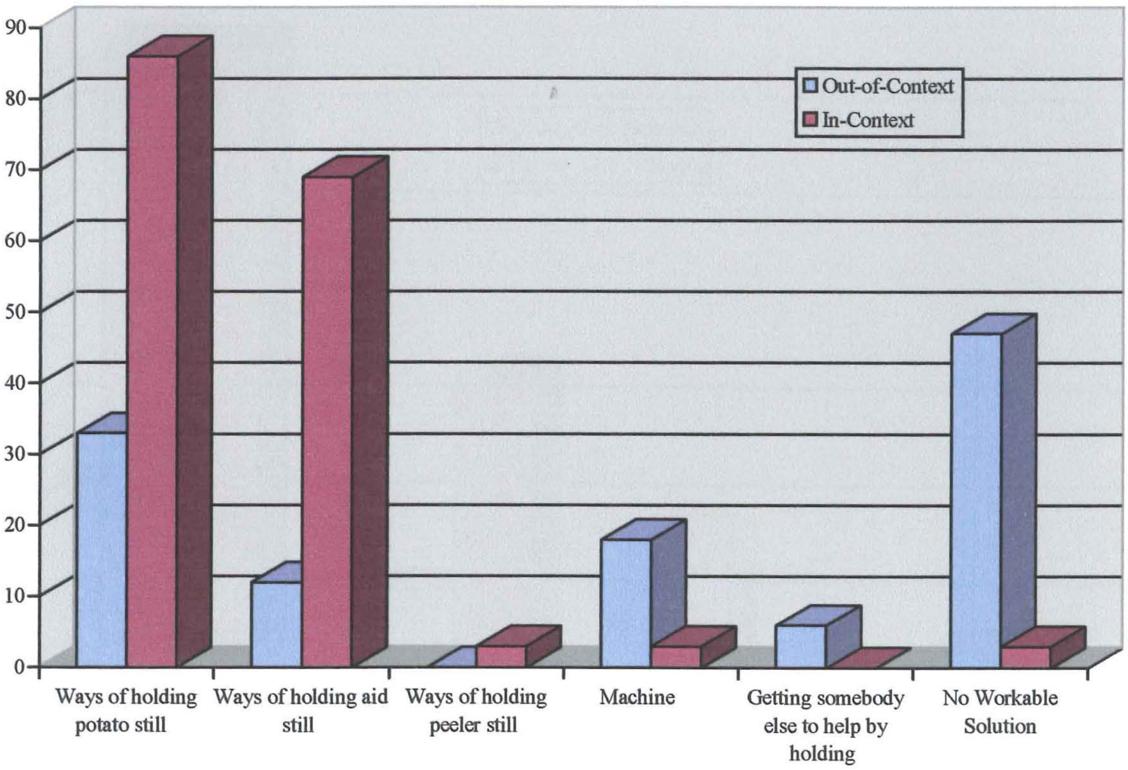
Quality of Explanation

	Quite detailed	***Rudimentary***	*No Explanation*
Out-of-Context	18	82	*0*
In-Context	75	25	*0*



Nature of solution

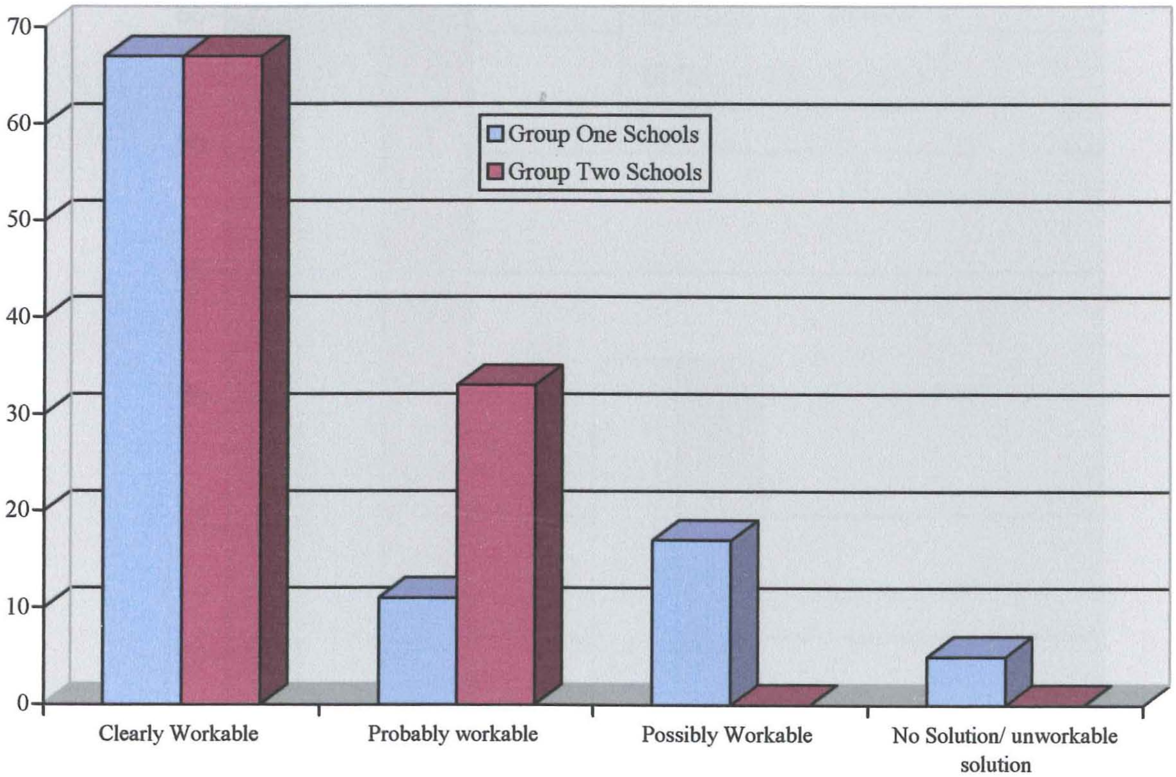
	Ways of holding potato still	*Ways of holding aid still*	*Ways of holding peeler still*	*Machine*	*Getting somebody else to help by holding*	*No Workable Solution*
Out-of-context	33	12	0	18	6	47
In-context	86	69	3	3	0	3



Results 'In Unit Task Test' Test School Compared to Control School

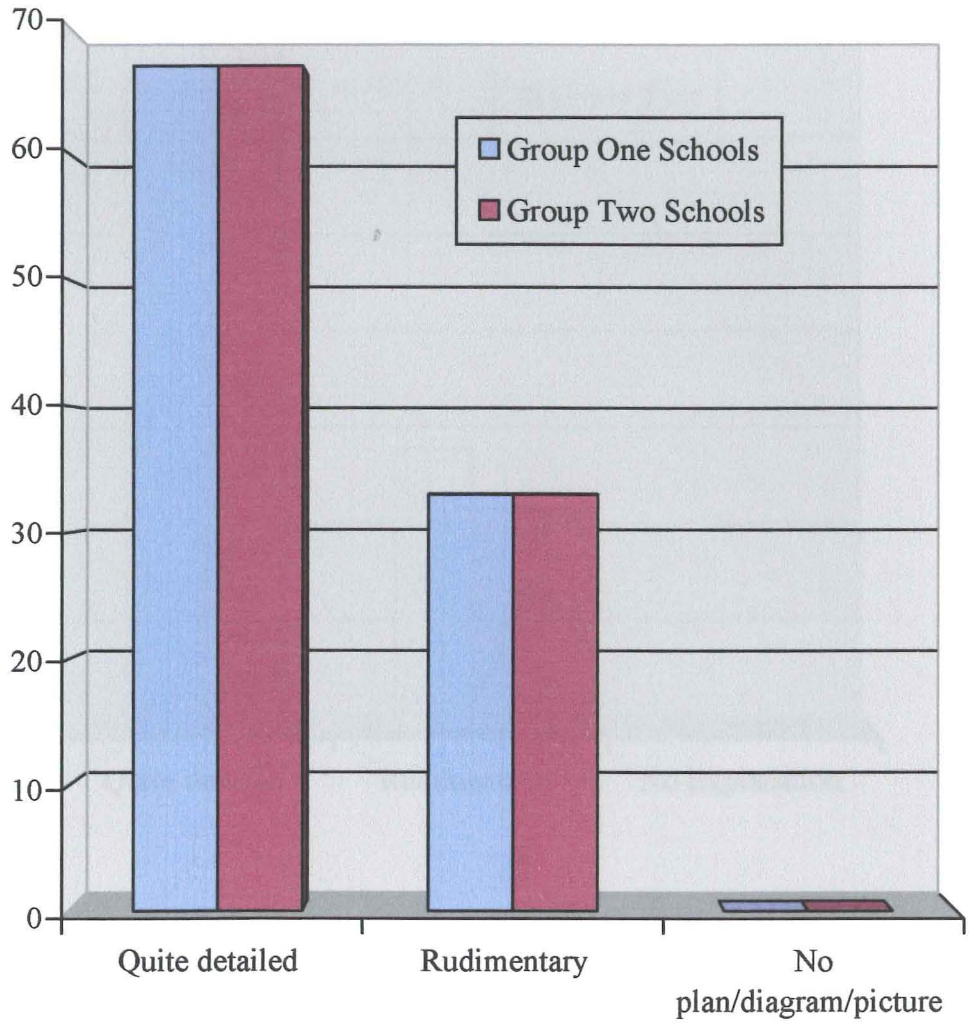
Quality of the Solution - % of children scored

Criteria Schools	*Clearly Workable*	*Probably workable*	*Possibly Workable*	*No Solution/ unworkable solution*
Group One	67	11	17	5
Group Two	67	33	0	0



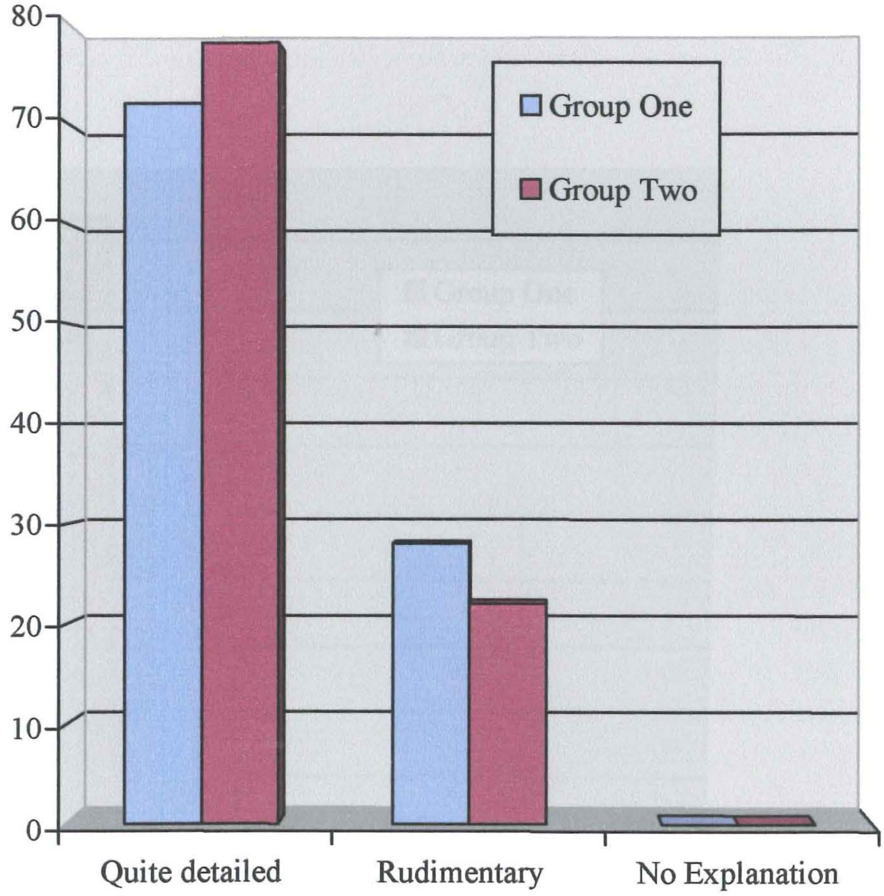
Quality of the plan/ Picture Diagram - % of children scored

Criteria Schools	*Quite detailed*	*Rudimentary*	*No plan/ diagram/ picture*
Group One	67	33	0
Group Two	67	33	0



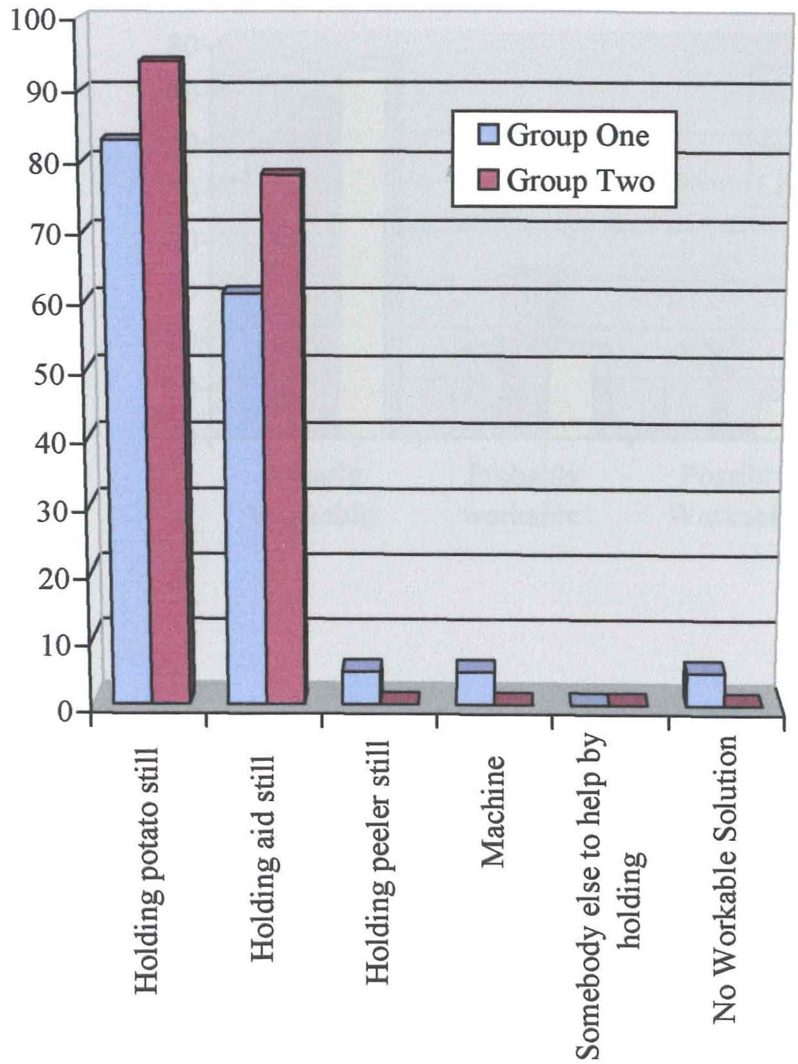
Quality of the Explanation -% of children scored

Criteria / Schools	*Quite detailed*	*Rudimentary*	*No Explanation*
Group One	72	28	0
Group Two	78	22	0



Nature of solution-% of scores received

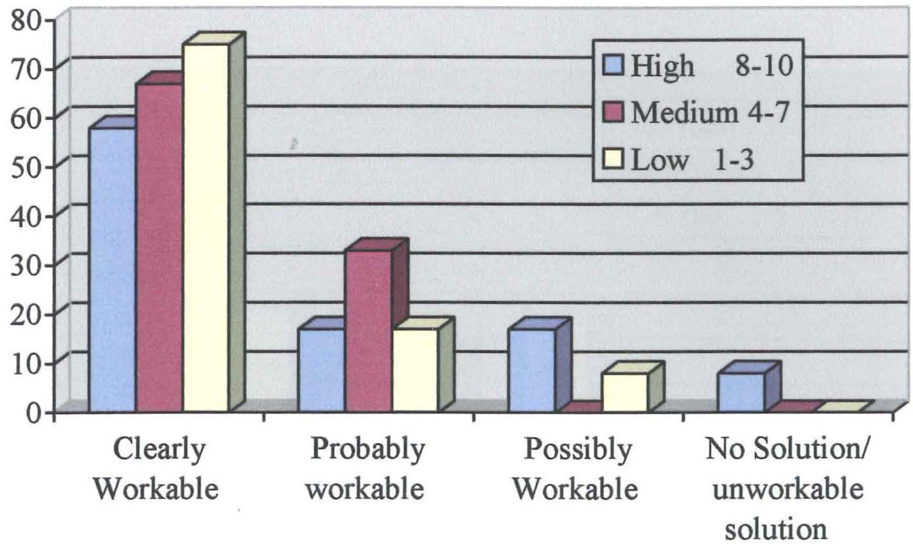
Criteria / Schools	*Holding potato still*	*Holding aid still*	*Holding peeler still*	*Machine*	*Somebody else to help by holding*	*No Workable Solution*
Group One	83	61	5	5	0	5
Group Two	94	78	0	0	0	0



Results 'In Unit Task Test' Compared Against Decile Bands

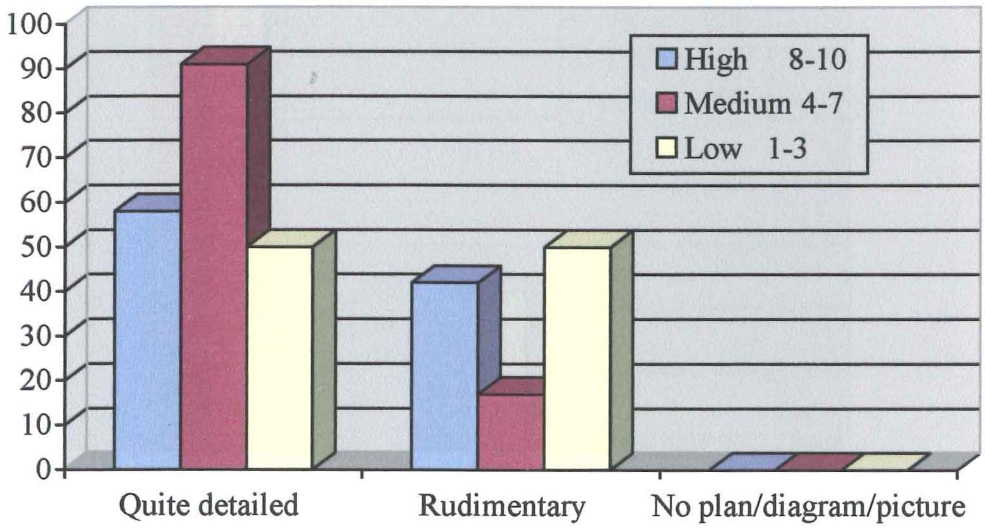
Quality of the Solution -% of children scored

	Clearly Workable	*Probably workable*	*Possibly Workable*	*No Solution/ unworkable solution*
High 8-10	58	17	17	8
Medium 4-7	67	33	0	0
Low 1-3	75	17	8	0



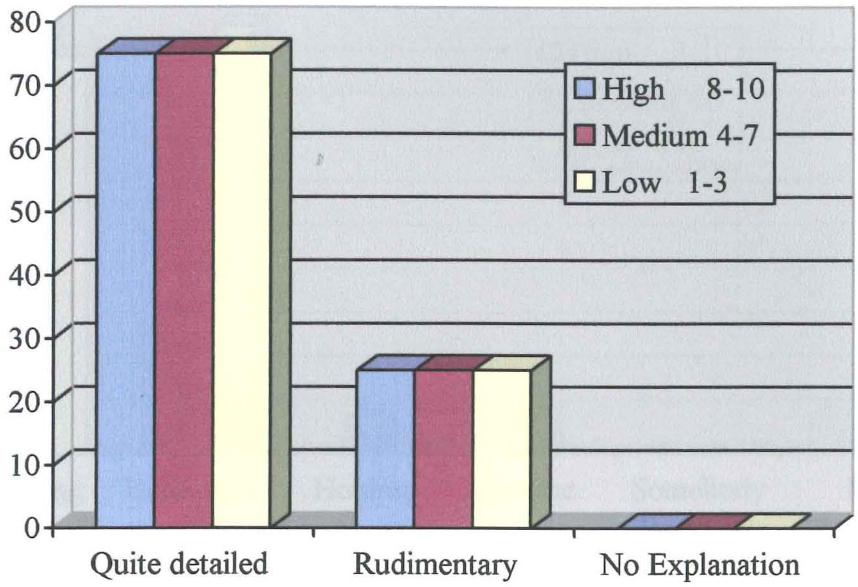
Quality of the Plan/ Picture Diagram- % of children scored

	Quite detailed	*Rudimentary*	*No plan/ diagram/picture*
High 8-10	58	42	0
Medium 4-7	91	17	0
Low 1-3	50	50	0



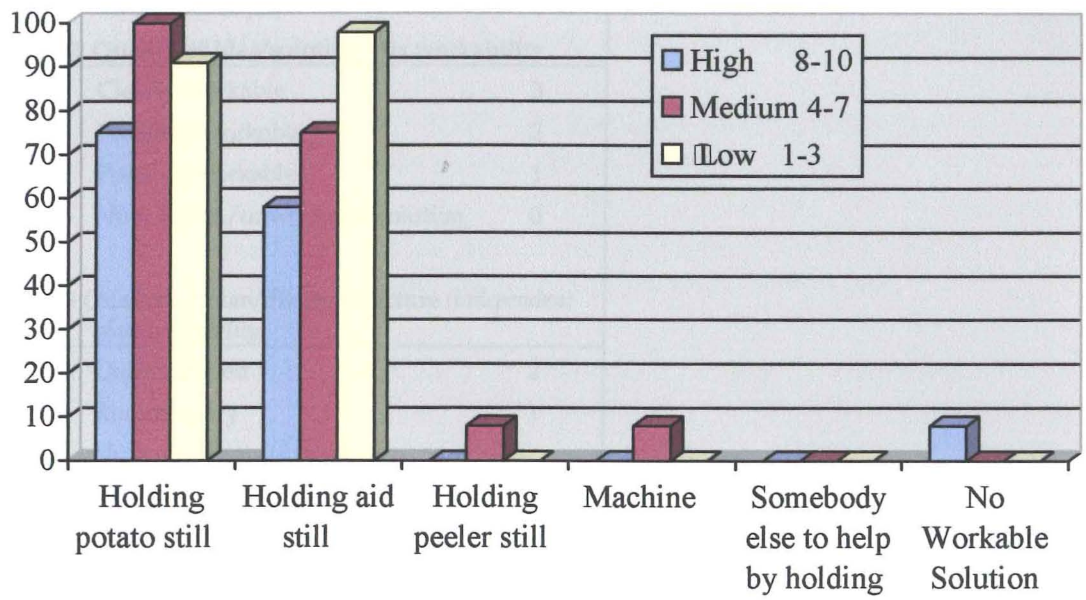
Quality of the Explanation- % of children scored

	Quite detailed	*Rudimentary*	*No Explanation*
High 8-10	75	25	0
Medium 4-7	75	25	0
Low 1-3	75	25	0



Nature of solution- % of scores received

	Holding potato still	*Holding aid still*	*Holding peeler still*	*Machine*	*Somebody else to help by holding*	*No Workabl Solution*
High 8-10	75	58	0	0	0	8
Medium 4-7	100	75	8	8	0	0
Low 1-3	91	98	0	0	0	0



Help Me Peel

◯ = unable to be scored

Filename: Tec16B
Station

Notes: **Paper only**

R1 A second person is required	
No solution	3
No	2
Yes - to assist	1
Yes - to peel the potato/ do the whole job	0

R2 Quality of idea/solution - Its workability	
Clearly workable	3
Probably workable	2
Possibly workable	1
No solution/unworkable solution	0

R3 Quality of plan/diagram/picture *(independent of its workability)*	
Quite detailed	2
Rudimentary	1
No plan/diagram/picture *(scored if there is no solution)*	0

R4 Quality of explanation *(independent of its workability)*	
Quite detailed	2
Rudimentary	1
No explanation *(scored if there is no solution)*	0

R5 Nature of solution	
Ways of holding potato still *(so can be operated with single hand)*	5
Ways of holding peeler still *(so can be operated with single hand)*	4
Machine (*can be operated with single hand)*	3
Getting someone else to peel potato	2
Getting someone else to help by holding potato *(so you can peel with single hand)*	1
No workable solution/any other response	0

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